December
1971
Price, $1.25

The Inauguration of M.I.T.'s 13th President

Institutional Assessment

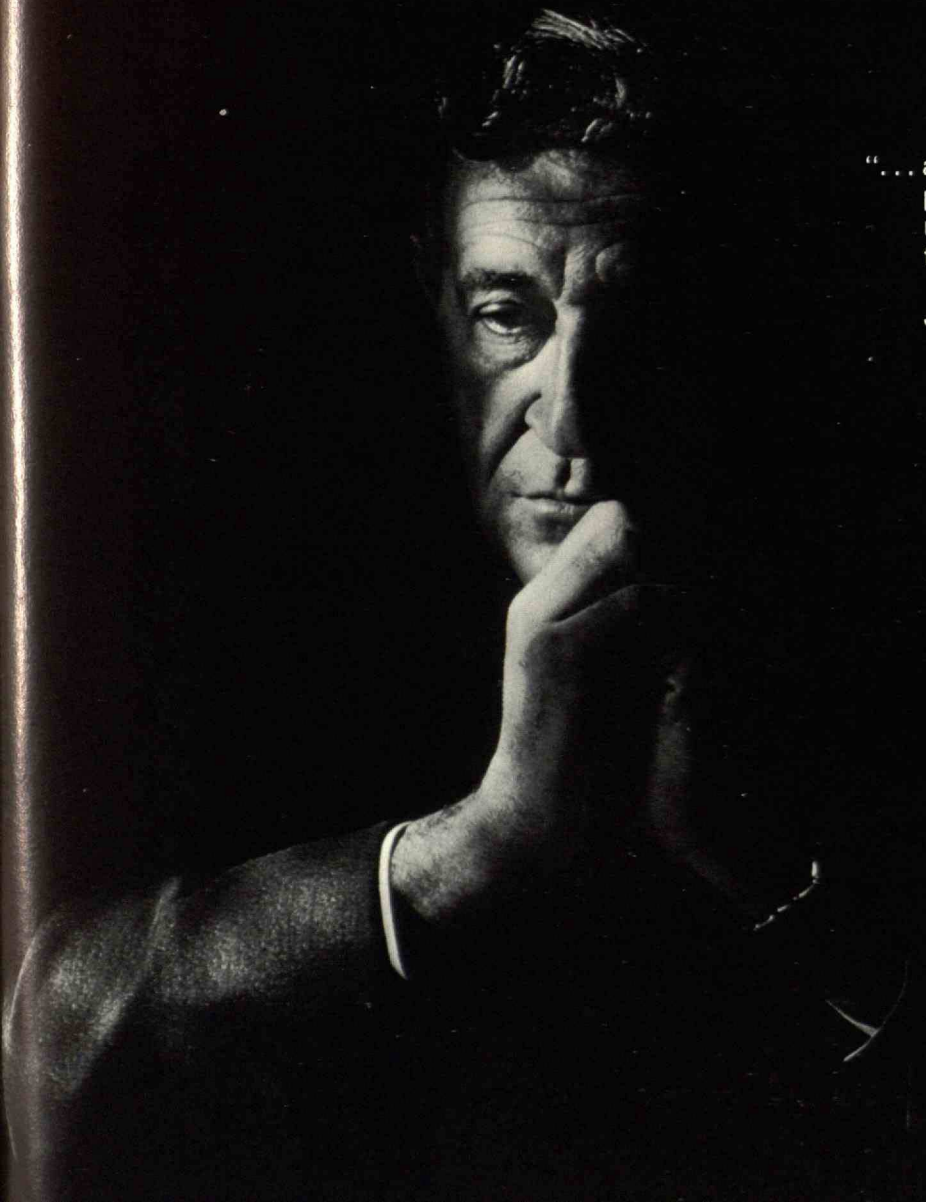
Redirection and Re-employment

Energy Technology to the Year 2000—Part II:

Pollution from Fossil Fuels, Combustion, and Waste Heat

Technology Review

Edited at the Massachusetts Institute of Technology



"... a renaissance among the professions in which man will replace machine at the center of the stage."

Jerome B. Wiesner

technology
review
Published by MIT

Nostalgia is a luxury the investor cannot afford.

Nostalgia is very big this year.

The old Saturday Evening Post is back on the newsstands.

No, No Nanette is back on Broadway.

A movie called Summer of '42 is boffo at the box office.

But while Main Street seems to be turning back the clock, Wall Street can't. For the substantial private investor there is, sadly, no return to those halcyon days when one's money made money in relative peace and tranquility.

These are the '70's — the challenging, changing '70's.

To provide aid and comfort to the serious investor (individual or institutional), the money managers at Old Colony Trust have published a booklet called, appropriately enough, Investing in the '70's. It outlines Old Colony's attitude toward managing other people's money, and discusses investment policies designed for the future.

If you are responsible for a sizable portfolio (your own or your company's), send for a complimentary copy of Investing in the '70's. Just write us at 100 Federal Street, Boston, Massachusetts 02110.

Old Colony Trust

A DIVISION OF THE FIRST NATIONAL BANK OF BOSTON

We worry about the "Air" in "Airport"

Since 1968, when NREC completed a comprehensive study of aircraft emissions, their impact, and control, our staff has conducted a continuing series of investigations of the nature and control of emissions from aircraft engines and on the distribution of these emissions as they affect the airport environment. These studies have had major support from the Environmental Protection Agency and the Federal Aviation Administration.

Current studies include the continued development of an atmospheric dispersion model for the analysis of air quality in airport vicinities. This model has been used to determine the total emissions from aircraft and other sources at specific airports and to calculate the exposures to these emissions by various recipients in and around the airport. Further studies have been conducted on the relative impact of these emissions from various sources on the community around the airport. One current study also includes experimental verification of a detailed dispersion model and an evaluation of modified aircraft ground operations as a method of controlling the impact of aircraft emissions.

Airport authorities and operations managers who are interested in the applications of the various models and computing systems to their specific problem are invited to write for further information to the Marketing Department, Northern Research and Engineering Corporation, 219 Vassar Street, Cambridge, Massachusetts 02139, or to call 617 491-2770.

Northern Research and Engineering CORPORATION

PRINCIPAL OFFICES are located in Cambridge, Massachusetts and London, England.

SALES REPRESENTATION in Washington, D. C., and Grenoble, France.

Technology Review

Edited at the
Massachusetts Institute of Technology
Volume 74, Number 2
December, 1971

Articles

Departments

The First Line

Getting On With the Job

Seeking a modern alternative to the traditional academic rituals, the committee charged with planning the inaugural of Jerome B. Wiesner as 13th President of M.I.T. conceived a series of panels and seminars to review the problems and opportunities of an institution presumed to be in the forefront of basic science and its applications to human affairs. Two features in this issue derive from the resulting events: Dr. Wiesner's inaugural address *(pp. 14-19),* and the tribute to him by Archibald MacLeish, a long-time friend and admirer *(p. 13).*

In addition to these features, the two weeks of inaugural events resulted chiefly in a renewed outpouring of words on all the issues in technological education and human progress familiar to those who have followed these professions for the past two decades: a dialogue on the dilemmas and conflicts—new and old—between and within science, technology, and society with which regular readers of *Technology Review* must be largely conversant. The place of basic science as a foundation for technology; can humanities make technology more humane? motivating students by showing them the practical as well as theoretical importance of what they learn; how (and if) students should be free to study what interests them, and if so how they shall acquire the fundamental understandings they must have to contribute in their professions; the necessity for interdisciplinary understanding in studies of today's complex problems; the frustrations of engineers determined to somehow make their profession more effective in solving a long and familiar series of contemporary frustrations; the fear that technology—already associated with most of man's problems—can in the future only add more disappointment and perhaps further reduce the chance of the species to survive; the unanswerable question of technology assessment.

Throughout its history engineering has had the most humane motive: to capitalize on physical science for man's greater comfort and accomplishment. Even if our definitions of accomplishment may change, we need hardly doubt that only more knowledge, more thoughtfully used and better understood by all, holds

the possibility of relieving whatever miscarriages technology may now seem to have visited upon us.

A week after the inauguration ceremonies, this Editor concluded to visit the American Commercial Fish Exposition in Boston; publicity promised sessions on the application of technology to commercial fishing. One large, barren room was designated for such presentations, a sort of sideshow to the exhibitions of boats, motors, and assorted marine gear—all sophisticated, shiny products of technology—which filled the John B. Hynes Auditorium. In that barren room, when the Editor chanced to visit, were one unattended movie projector and three viewers of its images.

While returning to the hustle of activity at M.I.T., it occurred to the Editor that, if very little remains to be said about bringing technology to social needs, much remains to be done.—J. M.

Technology Review, Reg. U.S. Patent Office, is published nine times each year (in October/November, monthly from December through June, and in July/August) at the Massachusetts Institute of Technology.

Inquiries regarding editorial contents, subscriptions, and advertising should be addressed to: Technology Review, Room E19-430, Massachusetts Institute of Technology, Cambridge, Mass., 02139. Telephone area code (617) 864-6900, ext. 4872. Technology Review is printed by the Lew A. Cummings Company, Manchester, New Hampshire. Second class postage paid at Boston, Mass., and at additional mailing offices.

Price: $1.25 per copy, $9 per year in the United States, $10 in Canada and foreign countries. Please allow three weeks for changes of address, and give both old and new addresses in all requests.

Technology Review is represented for advertising by: MediaRep Center, Inc., 1127 Statler Office Building, Boston, Mass., 02116, telephone (617) 482-5233.

The Editors' Desks

It's becoming popular among publishers to record with pride that their product is printed on "recycled" paper. We record —with mixed feelings—that *Technology Review* is not.

"Fine" papers—the grades on which books and magazines are printed—can now be made from re-used pulp. None that has been offered to the *Review*, however, is less than 20 per cent higher in cost than the sheets on which we now print, and none has characteristics of surface and opacity so satisfying to the Editor.

Today's economics simply do not—yet, at least—enable the *Review* to publish on recycled paper. Possibly this is proper. Timber is a regenerating resource, and many mills now claim to be growing more trees on their lands than they consume as pulp. Recycling pulp into "fine" paper may well require more nonrenewable resources than recycling it into coarse paperboards, a procedure familiar in the paper industry for many decades. Let it simply be recorded that conventional supply-and-demand economics may not always work to man's disadvantage, after all.

The Cover

The cover photograph of Jerome Bert Wiesner, 13th President of the Massachusetts Institute of Technology, was taken by John Loengard and first published in *Life* Magazine for June 9, 1967 (© 1967, Time, Inc.). It is reproduced, by permission, to celebrate the inauguration of Dr. Wiesner on October 6, 1971—of which further details are given elsewhere in this issue of the *Review*.

Next Month

Technology Review's series on "Energy Technology to the Year 2000" concludes in the January, 1972, issue with four important articles: electric power from fusion, by Lawrence M. Lidsky, Associate Professor of Nuclear Engineering at M.I.T.; problems in the regulation and construction of new power plants, by William W. Lowe of Pickard, Lowe, and Associates, Inc.; energy supply and demand as a factor in transportation planning, by Richard A. Rice of the Transportation Research Institute at Carnegie-Mellon University; and a national agenda for energy planning and research, by Hoyt C. Hottel and Jack B. Howard of the M.I.T. Department of Chemical Engineering.

Upon completion of the series, later in January, we'll offer in book form the entire series on "Energy Technology to the Year 2000."

In addition, *Technology Review* announces for January: "The Interactive Lecture," an account of new experiments using simple technological devices to assist in college-level education in the sciences, by Stewart W. Wilson, Assistant to the President of Polaroid Corp.

Authors

Harold Berkson
Must Fossil Fuels Pollute? pp. 34-43
is a specialist in environmental policy in the Library of Congress' Congressional Research Service. A graduate of Rutgers University, he holds advanced degrees from Amherst and the Scripps Institution of Oceanography and was for seven years associated with the Federal Water Pollution Control Administration (now the Water Quality Office). The paper published here was prepared for the American Chemical Society Conference on Chemical Technology for Resource Recovery.

Frank P. Davidson
The Case for Institutional Assessment, pp. 20-26
is Senior Research Associate and Chairman of the Steering Committee of the System Dynamics Group at M.I.T. Dr. Davidson lectures on macro-engineering, a field which he developed in theoretical studies based on wide practical experience. Dr. Davidson founded the international Channel Tunnel Study Group, whose recommendation of a billion-dollar permanent link between England and France has now been approved by the British and French governments. Dr. Davidson serves as financial adviser to a host of government and private institutions in the assessment and implementation of major projects. Sargent Shriver identified Dr. Davidson as the person who originated and carried out the innovation which led to the establishment of the Peace Corps. More recently, Dr. Davidson served as founding President of the Institute for the Future.

Donald R. F. Harleman
Heat—The Ultimate Waste, pp. 44-51
is Professor of Civil Engineering at M.I.T. He came to the Institute for graduate study in 1946 and joined the faculty upon completing work for the Sc.D. degree in 1950, and since then he has become well known for significant contributions to hydraulic and coastal engineering. His current research is in the field of his article

for this issue of the *Review*—thermal pollution and water quality effects of thermal stratification in rivers, reservoirs, estuaries, and coastal waters.

Harry Perry
Must Fossil Fuels Pollute? pp. 34-43
is Senior Specialist in Environmental Policy with the Library of Congress' Congressional Research Service. He assumed his present position in 1970, having been associated since 1940 with the Bureau of Mines (Director of Coal Research) and Department of the Interior (Mineral Resources Research Adviser); he is a graduate of the Universities of Pennsylvania and Pittsburgh in chemistry and chemical engineering. During the summer of 1971 Mr. Perry collaborated with Hoyt C. Hottel and Jack B. Howard of the M.I.T. Department of Chemical Engineering in a survey of new energy technology, a summary of which will appear in *Technology Review* next month.

Arthur M. Squires.
Capturing Sulfur During Combustion, pp. 52-59
who was among the speakers at the M.I.T. seminar on energy production in the spring of 1971, is head of the Department of Chemical Engineering at the City College of The City University of New York. The work which he describes on the capture of hydrogen sulfide by dolomite is supported by the Office of Air Programs of the Environmental Protection Agency. Among his colleagues who have contributed to the work are Professors R. A. Graff and R. Pfeffer, Dr. Melvyn Pell, and Messrs. Lawrence A. Ruth, Samuel Dobner, Leon Paretsky, S. Narayanan, Ralph Levy, Michael Somer, Basil Lewris, Lauris Sterns, John Bodnaruk, and George Di Iorio.

Raymond J. Waldmann
Federal Programs for Re-employment, pp. 27-31
received bachelor's degrees in chemical engineering and in humanities and engineering from M.I.T. in 1960 and 1961. After further study at the Harvard Law School (J.D. 1964) he joined Arthur D. Little, Inc., and was assigned to its Cambridge, London, and Brussels offices. Mr. Waldmann came to the White House staff in November, 1970, and has since then helped develop policy in the areas of revenue sharing, transportation, health, international economics, and technology.

Jerome B. Wiesner
Science, Technology, and the Quality of Life, pp. 14-19.
needs no introduction to an M.I.T. audience. The paper in this issue of *Technology Review* is his inaugural address as 13th President of the Institute. Dr. Wiesner first came to M.I.T. in 1942 from the Library of Congress, where he had been Chief Engineer for the Acoustical and Record Laboratory (hence his friendship with Archibald MacLeish—see pages 12-13); after World War II service in M.I.T.'s Radiation Laboratory, Dr. Wiesner joined the faculty in 1946 and rose—by 1962—to the distinguished rank of Institute Professor. Meanwhile, he had been Director of the Research Laboratory of Electronics and Science Adviser to President John F. Kennedy; since 1964 he has been Dean of the School of Science and later Provost of M.I.T.

The report by **Fred L. Robson** and **Albert J. Giramonti** (M.I.T.'62) (*p. 60*) is excerpted from a paper to the joint A.I.A.A./A.A.S. Committee on the Use of Aerospace Technology to Solve Social Problems (November, 1970), in whose proceedings it is published in full.

On the pages immediately following, two of *Technology Review's* regular correspondents are joined by **Ethan R. Signer,** Associate Professor of Microbiology at M.I.T., who records some impressions of his visit to the People's Republic of China during May, 1971 (*pp. 8-9*). Dr. Signer, whose professional interest is in the genetics of bacterial viruses, was accompanied in China by his colleague Professor Arthur Galston of Yale. The account in *Technology Review* is based principally on an article by Dr. Signer in the September, 1971, issue of *Science for the People.*

The regular contributors to this issue include **Robert C. Cowen,** Science Editor of the *Christian Science Monitor* (*p. 6*), **Victor Cohn,** Science Editor of the *Washington Post (p. 7),* and **Allan J. Gottlieb** *(p. 76*), graduate student in mathematics at the University of California (Santa Cruz).

We also call special attention to the review of *A Care for Nature* by Henry B. Kane *(p. 78)* Mr. Kane was the founding Director of M.I.T.'s Alumni Fund; the book is published posthumously. Its reviewer, **David McCord,** was for 37 years—as Executive Secretary of the Harvard Fund Council—the executive of the Harvard College Fund. Like Mr. Kane, Mr. McCord is well known as poet and artist, and the two collaborated as author (McCord) and illustrator (Kane) in two books—*Far and Few* and *For Me To Say.*

Letters

Technology and Democracy
It is quite clear, as Emilio Q. Daddario points out in "Technology and the Democratic Process" (*July/August, pp.18-23*), that the source of many of our problems is the interacting of technological innovation and economic growth. Yet with Mr. Daddario's notable exception, I had yet to see any article suggesting other than that more technological innovation and more economic growth will bail us out of our current disasters—environmental, social, and moral.

The one point on which I disagree rather strongly is the allegation that democracy is an "inefficient" system. This is perhaps true in terms of the very short run and with respect to certain inane problems which we can all mention, such as the refusal to embrace mass transportation systems; however, I would be prepared to argue quite strenuously that in the long run democracy is far and away the most efficient system. It is the only system I know of that has built-in feedback mechanisms which, given enough time, but which are admittedly agonizingly slow, will bring about adaptive change. To paraphrase a famous statement: dictatorships win the battles but lose the wars; democracies lose the battles but generally win the wars. But I do agree with Mr. Daddario in his suspicion that growthmanship and the technological impetus to neat solutions constitutes a profound threat to democratic processes.
David Sekler
Department of Economics
Colorado State University
Fort Collins, Colo.

Mr. Daddario responds:
To have excited comment on my article fulfills at least one of my objectives for having put it together in the first place. My fundamental goal, however, was to get people thinking about the further employment of science and technology so as to strengthen and not weaken our democratic society. Those who believe it can't be done have said I am optimistic. Those who believe it can be done believe that I am pessimistic. That proves, I suspect, that the proposition I have spelled out sort of balances out on the razor's edge, so that the situation can develop either way, depending on what we do.

I need not have used "inefficient" and "effective" in the same sentence, but I do think it can be defended. Inefficiency means "unable to effect or achieve the desired result with reasonable economy of means." Effective is defined as "adequate to accomplish a purpose; producing the intended or expected result." There is just a slight variation—but when you are walking a tight line, that has to be taken into consideration.

Investments and Employment
Your report "What Future for Engineering?" (*June, pp. 72-75)* comprises remarkably good coverage, engineering common sense, and a laudable lack of platitudes. There is, however, one economic area which Professor Thurow or Professor Samuelson should have covered (or covered and you missed?) which will have a major impact on engineers and other professionals for some time to come. Professor Samuelson comes closest to it in discussing "the engineer's lifetime dynamics . . . there is a premium on youth."

Over the centuries the merchant has placed a premium on youth for the sound economic reason that, other things being equal, he can get more physical output from youth per monetary unit of input. The more enlightened modern merchant (especially the larger corporations and even government) apply this principle profitably at the expense of the professionals. A professional's compensation (and the corresponding cost of doing business for the corporation) is so much cash, plus so much pension pay after X

years of work, plus so much other fringe benefits pay. The last two items may euphemistically be called insurance; the professional actually pays these, but because he does not transfer cash the corporation and income tax collectors agree that accounting principles make these gifts to the professional.

After 10 to 20 years of prudent investment the pension "gifts" amount to a tidy kitty. No corporation is a charitable institution, so few corporations can afford to part with this "gift." It costs only severance pay to abolish a job or lay off an "obsolescent" man so as to pocket the "gift" kitty. Upon hiring a young replacement the process recycles. The corporation has a windfall plus a cheaper replacement (experience has no monetary value because corporations "train" their employees). The "obsoleted" employee must start over again.

One remedy for an engineer against this racket is to secure vesting of a portable pension upon hiring. But this remedy may require unionization.

Mr. Alden failed to point out that corporations, government, and even universities customarily overstate their number of openings in order to increase their labor pool and improve their bargaining position.

W. J. O'Leary
Claymont, Del.

Mr. Alden replies:

Mr. O'Leary states something as a fact about employers that I do not believe can be proven. I have never seen any evidence of customary overstatement of openings on the part of employers. This may or may not be how they operate, but it does not agree with my own observations. In fact I find it difficult to understand how overstating the number of job openings would improve the employer's bargaining position, as the more openings there are in relation to the existing supply of manpower, the more choice available to prospective employees. This would seem to improve the employee's bargaining position rather than the employer's.

If you mean that employers and others have been overoptimistic in forecasting future needs for engineers, there are many who would agree with you, but this has not produced any great increase in the supply of college graduate engineers. Despite the favorable employment situation of recent years, the input of new engineering graduates at the bachelor's level into the U.S. work force has been relatively constant since 1958 despite the tremendous increase in the number of young people going to college. Much of the increase in the labor pool of people "employed as engineers" as measured by the U.S. Department of Labor is due to the inclusion of a large number of non-degree people, as much as 43 per cent according to a 1962 census study, who were hired because graduate engineers were simply not available. The unemployment rate for engineers between 1964 and 1969 was less than 1 per cent and practically no engineering graduates were without jobs by the time they left school.

Science Review

Robert C. Cowen

The Drive Toward Nuclear

If you could combine Superman, Moses, and St. George in an impressionist portrait, you'd have the self-image of the nuclear engineer. It presided over the Fourth United Nations "Atoms for Peace" Conference at Geneva last September.

There the specialists who have tamed the atomic dragon offered their victory to economic planners from 79 nations. After two decades of development, they could at last report that nuclear-electric power would be economically attractive in most parts of the world. With it, the specialists could build powerful new industrial muscle. And pointing ahead to a dimly-glimpsed promised land, these specialists talked of the "agro-industrial complexes" they could design to make deserts bloom and transform underdeveloped economies.

They cast themselves in a role to stir an engineer's heart. How disquieting, then, to realise that the public often sees them in the image of Faust. As Clarence E. Larson, Member of the U.S. Atomic Energy Commission (A.E.C.), told the conference:

"The A.E.C. staff have had the disconcerting experience of having members of an audience approach them after a presentation or debate to observe, in effect, that while the logic of our presentations persuaded the intellect, it left visceral doubts intact."

While the puberty rites for atomic power held center stage at Geneva, the theme of Commissioner Larson's lament was a constant background refrain. No one presented the critics' viewpoint at that elite assembly. Yet many American delegates, and to a lesser extent delegates from Europe and Japan, were seriously concerned about it. Even experts who have yet to encounter much opposition made their bows to the environment. They often expressed perplexity that their work should be suspect just when it has reached a long-sought success.

Certainly, the conference did mark a turning point in nuclear power development. In the past, the atom has been looking for its markets. Now the markets, so to speak, are in search of the atom. Some habitués thought the meetings lacked the sparkle of earlier such gatherings. They missed the point. This conference did not intend to open new vistas in a nuclear energy scene specialists already know intimately. This time it aimed to give planners and industrialists the perspective they need to integrate this new energy source into their national economies.

The "Underdeveloped" Market

Even the developing nations have adopted a new stance. Formerly, they were interested bystanders wondering when they could afford to buy into the rich nations' game. This time they came to Geneva as customers. By 1980, they may account for perhaps 15 per cent of the 300,000 Mw. of nuclear-electric generating capacity that Academician N. N. Bogolubov forecast the world should have by that year in his end-of-conference report. The trade journal *Nuclear Engineering International* estimates this means that several billion dollars' worth of orders will be up for grabs in the developing countries within the next two to three years.

For highly industrialized countries, the advent of economical nuclear-electric power is a timely gap-filler. Their energy planners at Geneva were certain that fossil-fuel plants could not possibly meet the rising electricity demand expected over the next two decades. In the long run, they said that breeder reactors and eventually perhaps hydrogen fusion power will be needed to keep energy-hungry economies humming. But breeders won't begin to count until the 1980's or early 1990's. And fusion still looks like a turn-of-the-century proposition at best. So the industrialized nations regard the tried and true nonbreeder fission plant as a useful addition to their energy options.

Developing nations often take a more ambitious view. They regard nuclear power development as a force that could help industrialize their whole economies. Even when they buy plant and know-how elsewhere, they want to learn as much as they can, do as much of the job themselves as is possible. Their delegations came to Geneva fortified by years of careful homework. They know how nuclear power could fit into their economies as a catalyst for growth.

India, with the grandest plans, typifies this attitude. India's Atomic Energy Commission Chairman Vikram A. Sarabhai candidly explains that early plans failed to reach their goals because they neglected the need to build an adequate infrastructure for nuclear power. Earlier efforts trained nuclear experts while failing to provide adequate steelmaking. They taught India how to build an atomic power plant on its own. But they overlooked such obvious needs as transportation for the outsized components such plants often have. The newly approved 10-year nuclear plan embraces such peripheral matters. It aims to build the industrial capacity India needs to be a nuclear nation. That includes developing India's own uranium and thorium fuel resources. It may also include developing nuclear explosives to be used for peaceful construction purposes, Mr. Sarabhai says.

"A Task That Approaches the Fantastic"

When you realise that countries like India consider atomic power a key to an industrial future and that advanced countries think it essential to continued economic growth, you sense the drive toward a mushrooming of atomic-electric power throughout the world. Academician Bogolubov considers his anticipated 300,000 megawatts by 1980 a merest beginning.

Over the ensuing two decades, he expects that capacity to grow by a factor of eight to ten. "It is an understatement," he observed, "to say that this is a highly complex and difficult problem requiring the participation of scientists, engineers, and industrial planners of the whole world for its solution. It is a task that approaches the fantastic."

No expert would claim that such a task will be devoid of dangers. At Geneva, speakers repeatedly stressed the need to maintain tight standards to prevent atomic power plants from radioactively polluting the world. They expressed concern about the growth of plutonium supplies, some of which might be secretly diverted to bomb-making. R. Rometsch, Inspector General (Safeguards) for the International Atomic Energy Agency, says he's encouraged by progress in measures to prevent such diversion as his office prepares to set up the inspection system authorized by the Nuclear Nonproliferation Treaty. He adds, "However, this should blind no one to the fact that there is much left to be done."

Then there's the explosive growth expected for radioactive wastes. Experts generally believe they know how to care for such dangerous wastes safely and economically. Nevertheless, Y. Sousselier and J. Pradel of France voiced a growing uneasiness when they asked if it might not be time to put such waste management under international control. They noted that some countries now planning atomic power programs lack the economic resources or suitable disposal sites, or both, to handle their own wastes. Beyond this, they noted that, as decades become centuries, it will be much easier to keep track of the wastes if they are cared for at well-known international sites.

While they do express concern, these are the kinds of problems the nuclear experts love. They approach them with a sense of mastery, a confidence in their ability to cope. Glenn T. Seaborg, retiring Chairman of A.E.C., reflected their attitude when he explained that it is misleading to call atomic power "inherently" safe when it definitely is not. "My point," he said, "is that these dangers can be contained. I have thought a great deal about this. I think the risks are manageable."

Dodging More Fundamental Issues?

To many of these experts, public opposition to atomic power springs from ignorance or distrust of a technology once associated with the atomic bomb. Given adequate "education," they expect such opposition to disappear. It seems to be inconceivable to them that any well informed and rational person would question their underlying faith in technology itself.

A few outsiders, young people, got nowhere when they tried to introduce such skepticism through a printed statement. This says in part, "It is not necessary to be an 'expert' . . . to understand . . . a single species has colonized a whole planet and now is proliferating at exponential rates and degrading matter and energy even faster, . . . to understand that our planet is a space ship and that the predicament facing our generation is to prepare and promote the passage to equilibrium. . . ."

Most delegates ignored the statement and its implied further questions. Is reliance on power-hungry technology the most effective solution to environmental problems and overpopulation? Is Western-style industrialism the best future for developing countries? Are nuclear planners dodging these fundamental issues in striving to provide a source of more electric power?

At least some delegates from America, where the opposition has been strongest, did not turn these issues aside as easily as many of their colleagues. Although he remained in the background of a conference at which Dr. Seaborg presided and to which he led the American delegation, the new A.E.C. Chairman, James R. Schlesinger, explained in private the philosophy on such matters he has later made public.

The Option To Opt Out

Reversing a decades-old policy, he says, the A.E.C. no longer is in the business of "promoting" atomic-electric power. Its enabling legislation charges the A.E.C. with promoting the peaceful uses of atomic energy. Dr. Schlesinger now takes this to mean promoting the public good in respect to such uses, not pressing the case for the atomic power industry. The A.E.C., he says, will vigorously develop the most attractive types of atomic-electric power plant to the point of commercial utility. But this is merely to provide the public with the maximum number of options in deciding how to meet its energy needs. If the public decides to reject atomic power, that is its right.

While he does not himself believe the American people would opt to cut down on electricity consumption, he says that to question the ever-growing use of electricity is a legitimate public concern. He told the October meeting of the Atomic Industrial Forum and American Nuclear Society that the commission will not itself become involved in the issue of whether America "should curb its appetite for energy." However, he said, "Environmentalists have raised many legitimate questions. A number have bad manners, but I believe that broadside diatribes against environmentalists are not only in bad taste but wrong."

Dr. Schlesinger's philosophy is foreign to the spirit of the Geneva conference and hence to the thinking of most of the world's nuclear fraternity. But I think it will be found to be the keynote of mankind's nuclear future. The 1970's will undoubtedly be the decade in which atomic-electric power begins to come into its own around the world. It will also be the decade in which the self image of the nuclear engineer gets a drubbing as he comes to terms with a public that doesn't quite trust him.

Washington Report

Victor Cohn

The Candybox Falters

Texas survives here. The events of the Washington autumn were the President's wage and price freeze, generalissimoed by a Texan, the purchase of the baseball Senators by big bidders from Big D, and the opening of the Kennedy Center. The Kennedy Center, though nobody may have thought of it this way before, *is* Texas in Washington—American bigness, big culture, big space, Bernstein and red carpets, Vivaldi and vulgarity, with a taste of champagne in a plastic glass for a buck and a half a throw during intermission. All as a vehicle for bringing this city or megalopolis or confluence of ghettoes and shopping centers, or whatever it is, the loveliest music that it has ever heard.

The John F. Kennedy Center for the Performing Arts, 630 feet long, wrapped in 3,700 tons of Carrara marble and dedicated in 3,700 tons of verbiage, opened in September and was promptly labeled by various critics and journalists:

"The great white houseboat on the Potomac."

"A concrete candybox."

"A Brobdingnagian shoebox."

"A marble sarcophagus in which the art of architecture lies buried."

It is easy to go on. The world's largest Kleenex box. Grant's Tomb South. The Great White Hoax. The Tomb of "The Chocolate Soldier." Just a kitsch in the dark. "Tell me," a friend wrote from New York, "is it really as bad as they say?"

Answers: No and Yes

"This capital city," said Ada Louise Huxtable in the *New York Times*, "specializes in ballooning monuments and endless corridors. It uses marble like cotton wool. It is the home of government of, for and by the people and of taste for the people—the big, the bland and the banal. The John F. Kennedy Center does not break the rule. . . Albert Speer would have liked it."

The architectural features most flayed are the dull, monolithic exterior—Edward Durrel Stone's latest throe—and (again Miss Huxtable) "the 600-foot-long, 60-foot-high grand foyer (the length of three New York City blockfronts), one of the biggest rooms in the world, into which the Hall of Mirrors at Versailles could be cozily nested." A great corridor, someone else said, for an auto race.

In defense of Stone, it should be said that he had a difficult commission—to place within one set of walls, for economy, three separate facilities: a 2,760-seat concert hall, a 2,334-seat opera

(and ballet and musical) house, and a 1,100-seat theater, as well as offices, a film theater, a good-sized assembly hall and three restaurants.

How could such a building help but be a behemoth? Imagine New York City's Lincoln Center under one roof. One of Stone's further impediments is that he was not given a grounds to surround and soften this monster, but was instead forced to wedge it into a kerchief of land inside a spaghetti of streets, roads, access roads and the river.

As for the Grand Foyer, appallingly huge and empty as it is when unoccupied, it is amazingly correct when it is used. Filled or near-filled with concert- and play-goers, sometimes, from *three* simultaneous performances, it is remarkably quiet and seemingly uncrowded. Stone scored here.

He and his collaborators scored highly too in the performing spaces as places to see and hear dance and music. Lincoln Center's Symphony Hall was plagued from the beginning with bad acoustics; some of its problems are permanent. The Kennedy Concert Hall unfortunately does have a couple of hundred upper-tier seats with obstructed views. The center claims this unavoidable, and "common" along the steep sides of the world's "great," U-shaped concert halls after which this hall was modeled. Maybe so. But a poor job has been done by some promoters—several use the center—in identifying these seats in advance and graciously making refunds if concert-goers are dissatisfied. "Next year," promises the center, "we'll do better."

As for the quality of the sound of a symphony orchestra here, it is clear, lively and precise. It is not a sound to be relished by one who (like I) sometimes likes to doze during a duller piece. It is a sound to be relished by one who (like I) goes to a concert for an emotional experience, not just to be lulled. It is a place in which to listen, and to hear notes and instruments that one has not heard in inferior auditoriums. Architecturally, then, this center can be considered a visual bleh but a functional triumph. So much for us music lovers—we're pretty happy.

But it is Not for All

But if architecture is something more, if it is a part of a larger technology, if it is not just building a building but—in the phrase of Moshe Safdie—if "architecture is building environment well," then the Kennedy Center has to be called a failure in terms of the kind of environment that Washington needs. First of all, there is that location, hemmed in on one side by the river and on the others by a maze of roadways that were already confusing and over-crowded before this new traffic magnet even opened. The center, its area and its underground garages will very likely be strained whenever there are three performances occurring on one night. And the public transportation to the place, like all public transport here, is so far bad.

The center is plainly designed for easiest access by the automobiled, not by the poor, which includes a large share of the 72 per cent black population of the District of Columbia. Architecturally (Safdie definition) and geographically, this is a place for the white residents of Northwest Washington and the Virginia and Maryland suburbs. Flanked by the Potomac and the Watergate luxury apartments and not much else, it is a place where they need not look on the real Washington.

The real residential D.C. and the old downtown D.C., as contrasted with the white sectors and the flourishing new white downtowns springing up along Connecticut and Wisconsin Avenues, are increasingly decaying places. They are not the places where Woodward & Lothrop and Raleigh's and the Hecht Company build their new stores; they barely maintain the decency of their old ones. White residents make quick forays to the National or Ford's Theater. A high crime rate, aggravated by the emptiness and decay of the streets, aggravated by the lack of anything else to do, scares them off.

President Nixon is no exception. He has journeyed into the ghetto and gotten out of his car to press a little flesh exactly twice. He had been urged to do so the first time by his then domestic aide, Daniel Patrick Moynihan. They visited an area razed after the 1968 riots, in token of rebuilding that was supposed to come. The rebuilding of the scorched riot corridors has not yet started. Other redevelopment plans, some merely substituting more concrete for living people, are likewise stalled. All are the victims of D.C. government and citizen ineptitude and the kind of Presidential and Congressional disinterest that left D.C. a neglected place for so many decades—and permitted Congress to "give" the Kennedy Center only that fortress-like Potomac site.

Placed in the heart of urban Washington, like the Lincoln Center was placed in Manhattan, the Kennedy Center could have been an important device to attract new crowds and new restaurants, shops and other attractions. There is virtually no room at all for any such within blocks of the present site. The Kennedy site, in other words, could have been one that said to all people, "This is yours." It is not, and in four visits so far to the center—for three concerts and a ballet—I have not seen more than an occasional black face among the audience.

I am told that this was not true for the performances of Leonard Bernstein's hugely popular contemporary Mass that opened the opera house. The center cannot be moved now. Perhaps artistically at least it can appeal to all Washington. There are plans in that direction, but it will surely be a struggle. The box office rules, and the box office is not likely to be jammed by citizens cut off by so great a cultural and architectural gap.

Special Report

Ethan Signer

New Directions in Chinese Science*

Last May, another biologist and I spent two weeks in the People's Republic of China, visiting various scientific establishments, talking with Chinese scientists and seeing the country in general. We were shown Chungsan University (Canton), Peking University, and Futan University (Shanghai); the Academia Sinica Research Institutes of Botany and Microbiology in Peking and of Biochemistry and Plant Physiology in Shanghai; an Affiliated Hospital of Peking Medical College; factories, a commune, the Forbidden City, and so on.

We found that, under the impetus of the Cultural Revolution, the Chinese are reorganizing their scientific establishment according to a reassessment of their needs. They seem to be trying to integrate scientific research more closely with the immediate requirements of industry and agriculture, and to do away with social customs that made scientists and other professionals elite classes culturally distinct from ordinary people.

Combating Elitism

The attempt to disestablish scientists as a privileged elite—while continuing to accept them as useful members of society—is being done partly through political education that stresses the virtues of workers and peasants. In the early days of the Cultural Revolution, extensive reorientation classes for intellectuals were apparently quite common. Many still spend several months at the May 7 Cadre Schools (named after the date they were proposed) where they learn to serve the people by accustoming themselves to manual labor, learning peasant skills such as farming and building huts, and studying Mao's ideology.

"Serving the people" is expected in ordinary jobs, too, where those in positions of authority still take turns doing the necessary menial work, and everyone is expected to spend time studying and discussing Mao's precepts—as at Chungsan University where the professors meet to do so for an hour a day. At Peking University, faculty duties are said to include research, teaching, and manual labor in agriculture or industry; faculty are expected to spend several months to a year alternately in each occupation.

Factory workers and peasants are apparently being brought into the decision-making process. Instead of traditional management personnel (cadres) only, all institutions, scientific and otherwise, are

* Adapted with permission from *Science for the People*, September, 1971.

now run by elected Revolutionary Committees constituted according to the "three in one" principle: cadres, ordinary workers or peasants, and army or militia. (The army does not seem to be included as a military presence, but rather because of its political loyalty to Mao.) The net effect is to increase participation of and answerability to ordinary people, and at the same time to control political direction. Although we had little chance to observe the interplay of central and local planning, I had the impression of some flexibility and independence at the local level within broad guidelines set by the government.

The practice of having scientists do part of their research work at factories and communes, and workers and peasants spend time in research laboratories, also helps break down elitism. Intellectuals are officially encouraged to pay close attention to suggestions from ordinary, untrained people, and several scientists offered us unsolicited instances from their own experiences. At the Microbiological Institute in Peking, it was a visiting worker who suggested correctly that the efficiency of the industrial process for converting starch to glucose (by means of an enzyme) could be improved by making the enyzme insoluble. Other scientists working there on contamination of industrial bacterial cultures with several viruses were having trouble obtaining multiple-resistant strains, but at the suggestion of a factory worker seemed to have success using instead mixed cultures of singly resistant strains. In Shanghai Dr. Loo Shi-wei, trained at Caltech and now at the Botanical Institute, knew (as do U.S. scientists) that the hormone giberellin normally increases plant growth rate but not final yield; however, he was able to increase yield by 20 per cent by applying it at the flowering stage rather than the orthodox seedling stage, at the suggestion of a peasant at the Malu Commune where he has lately been working. And when scientists began going to factories to find out about production problems, we were told, the experienced workers took pains to help them learn. These examples were quoted, not to pretend that peasants and workers are automatically always correct, or that uneducated people are necessarily smarter than educated ones. Rather, they were to emphasize the current notion that suggestions should be evaluated only on their merits, and that even uneducated people can make valuable common sense suggestions—in contrast with the situation before the Cultural Revolution when, it was said, experts and intellectuals would not deign to accept advice from uneducated people.

A similar leveling process is said to be occurring within the research groups. At the Microbiological Institute in Peking the title of professor has officially been abolished (although it seems still to be used deferentially for older scientists), and all the scientists are considered research workers at the same level. There are still heads of research groups, but whereas they used to make all decisions, now "bright young persons can insist on the truth, which is sometimes in the hands of the minority." Anyone can suggest a research project, although the final decision on adoption rests with the Revolutionary Committee of the Institute or even a higher authority.

Reorganizing Education

This reduction is changing the character of higher education. Last fall, the Universities accepted their first classes since the Cultural Revolution began in 1966, but the students are no longer chosen directly from secondary school on the basis of competitive examinations. Instead they are primarily workers, soldiers and peasants who must have spent at least a few years (and often longer) working in production, before they may be recommended to the University by their factory or commune. Most are expected to have finished secondary school, but private study apparently may do instead. The competitive examinations seem to have been replaced by a more informal assessment of educational, political, and social qualifications. Quotas for the different departments are established by the government, but the University allocates the individual students, respecting preferences where possible.

Although a University placement committee assigns jobs where necessary, most of the students say they will return to their old jobs after two to three years at the University. (When asked directly what they expected to do after graduating, almost all the University students we talked to answered at first, "Whatever the country needs.") Thus most science education is geared directly to industrial or agricultural production. A few of the science students will go on to further study and careers in research. But although the number for any subject is fixed by the government for each University, it is the students and faculty who are said to select the individuals by discussion of both professional and political qualifications, with final approval by the University Revolutionary Committee.

The University curriculum, too, is being altered to suit production. At Chungsan University the Biology Department used to include zoology and botany sections, but since the Cultural Revolution it has been divided into industrial biology, agricultural biology, and traditional herbs. In order to combine research, teaching, and production, the University now has a small pilot plant producing the antibiotic tetracycline on the campus—built by students, faculty, and staff—and is carrying out several collaborative projects with outside factories and agricultural communes. The new policy is frankly experimental and still in its early stages, but, certain trends were, nevertheless evident.

Research Priorities

The quality of most of the scientific research we saw was modest. This is hardly surprising considering that, when China emerged from feudalism as recently as 1949, there were only 125,000 college-trained people in the entire country (there are now said to be over two million), and in that sense progress has been quite significant. On the other hand, there were significant exceptions, such as the synthesis of insulin, the production of a birth control pill, and the use of giberellin to increase plant yield. The Chinese have also made great strides in the physical sciences. The social upheavals of the early years of the Cultural Revolution largely halted scientific research, like many other aspects of Chinese life, but the laboratories we visited appeared fully staffed and running at a normal level. China has obviously suffered a short term loss in scientific productivity, but in the long term this will have to be evaluated in the light of ultimate gains from the reorganization of research under the Cultural Revolution.

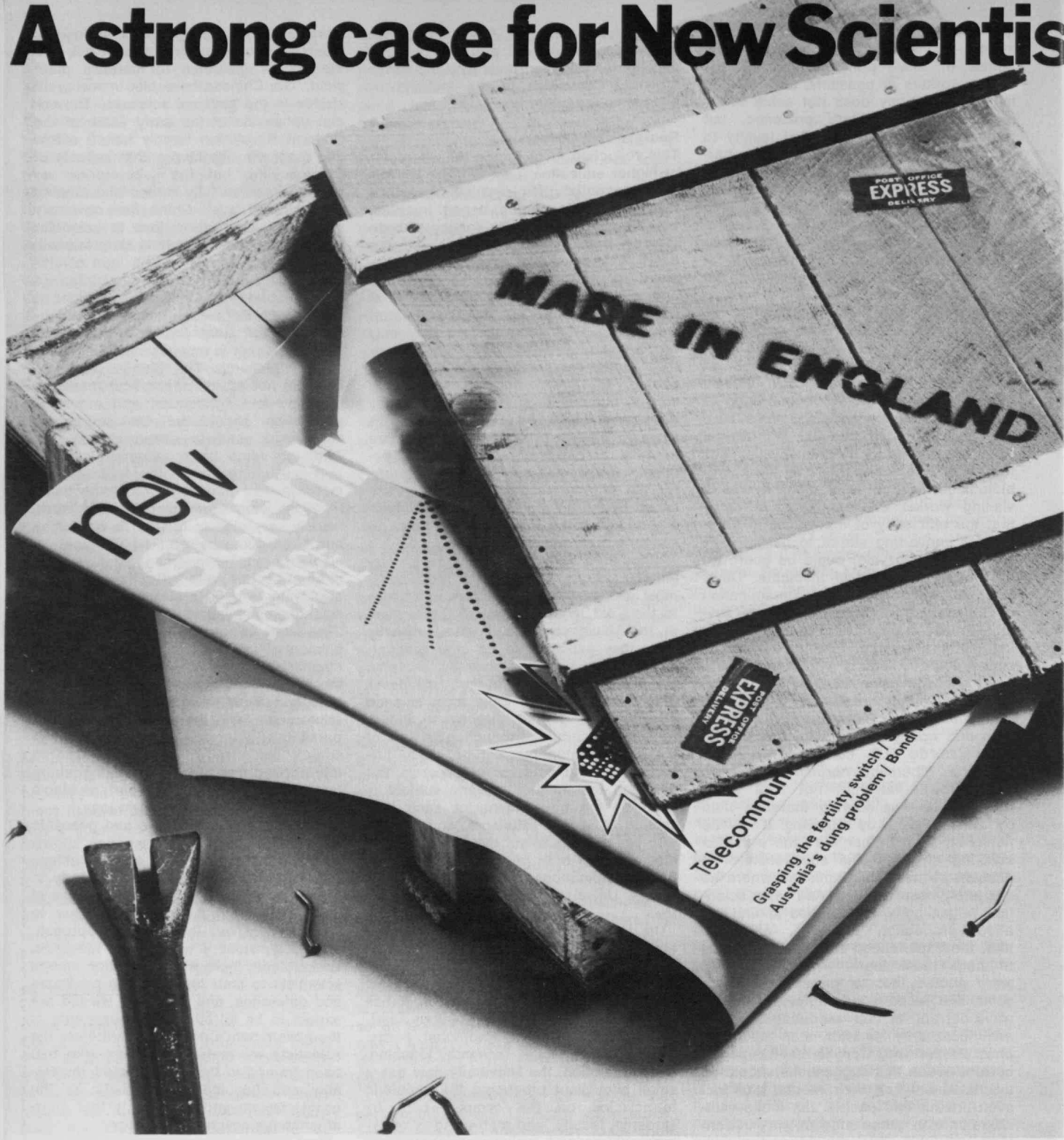
The most significant change in scientific research since the Cultural Revolution is the shift in emphasis from basic to applied research. The Chinese maintain they are not against theoretical research, but they feel agricultural and industrial production should be the source of knowledge used to construct theories. Although some basic research is probably still going on, all the scientists we met who had formerly been doing basic research were now doing applied work, usually very closely related to what they had been doing before. The Chinese are also very much concerned, in science as in other sectors, with self-reliance, and so are trying to build a strong, independent scientific establishment.

The shift to applied science is complemented in scientific education by the emphasis on workers and peasants, and the fairly direct connection with agricultural and industrial production. It is also reinforced by the development, in parallel with large scale science in research institutes, of scientific research into applied problems on a small scale in factories and communes—part of Mao's general policy of "walk on two legs."

The emphasis on workers and peasants and on practical, common sense knowledge, and the efforts to combat elitism and "serve the people", seem already to be affecting the priorities and attitudes of scientists. It is easy for a Westerner to be cynical about this sort of approach, and to consider it unworkably idealistic. Undoubtedly there was opposition among scientists to their loss of class privileges and deference, and of course we did not expect to be introduced to opponents of the government's policy. Nevertheless the scientists we met—even those who had been trained in the US—seemed remarkably and genuinely sympathetic to the egalitarianism and practicality that characterize the new science policy.

Most of them were aware of the general outlines of recent Western scientific progress, if not the details. But although they seemed politely curious about us as Americans and about American science, and those who had studied in America sometimes asked after their former institutions and friends, we definitely did not have the impression that they felt cut off from the West or were thirsting for knowledge of it, but rather that they were simply preoccupied with their own concerns. As one physician said, explaining why she had gradually stopped corresponding with former acquaintances in the U.S., "We don't seem to have very much in common."

A strong case for New Scientis



There are lots of solid reasons for reading New Scientist. But the one that weighs most with most people, is that it's weekly. That it's a news magazine.

New Scientist correspondents cover all fields of science and technology and all parts of the world. And every week, they pack the magazine's unique news section with vital up-to-the-minute news items.

Feature articles and regular columns too, are topical – making a weekly package that deals completely with the current scientific scene.

To receive New Scientist regularly, use the coupon to open a subscription. We will then airfreight copies to you each week: an urgent consignment of up-to-date science and technology.

To: New Science Publications, IPC Magazines Limit
300 East 42 Street, New York, NY 10017.
Please enter my subscription to New Scientist for:
☐ 1 year $20. ☐ 6 months $10.
☐ Please send me a free sample copy.

Name _____

Address _____

New Scientist

A good way to remember

M.I.T. CHAIR

Famed for quality craftsmanship, selected northern hardwoods, with gold M.I.T. shield, gold decoration on handsome black finish, the M.I.T. chair has earned the right to be a tradition. Choose black arms, $46, or cherry arms, $46. Red and grey Duraleather covered cushion, $11.

DIRECTOR'S CHAIR

Features the 3-color M.I.T. crest on the heavy white duck and black or natural varnish finish on the sturdy, foldable frame, $18.95

INSIGNIA GLASSES

The white Tech crest is fired on handblown quality glassware with platinum rim. Order Hi-Ball, $1.25 each, $14.00 per dozen or Double Old Fashioned, $1.30 each, $15 per dozen.

PERSONALIZED PLAQUES

Cast bronze M.I.T. emblem is mounted on solid hand-rubbed walnut, shaped as a shield or rectangle (both 8½" x 11"). Graduate's name is engraved on the brushed sheet bronze nameplate. Engraving is filled with black inlay so letters appear in distinctive double outline style. Excellent gift idea. Order from Tech Coop. $18.95.

SCHOOL TIES

The M.I.T. shield is woven in a repeated pattern on plain backgrounds of red, black or navy. Fine quality silk repp, $6.

the Coop

M.I.T. Student Center
84 Massachusetts Avenue
Cambridge, Mass. 02139

PLEASE SEND:

☐M.I.T. Chair with black arms	Express collect	$46	-------
☐M.I.T. Chair with cherry arms	Express collect	$46	-------
☐M.I.T. Cushion		$11.	-------
☐M.I.T. Director's Chair, Natural	Express collect	$18.95	-------
☐M.I.T. Director's Chair, Black	Express collect	$18.95	-------
			Totals
☐Hi-Ball Glasses	@$1.25 ea., @$14.00 dz.		-------
☐Double Old Fashioned Glass	@$1.30 ea., @$15.00 dz.		-------
☐Red ☐Black ☐Navy Tie(s)	@$6. ea.		-------
☐M.I.T. Plaque with nameplate		$18.95	-------

Graduate's Name _____

Class of _____

Please ship to: _____

Address _____

_____ Zip _____

Ordered by: _____

Address _____

_____ Zip _____

Coop # _____

Charge my account ☐ _____

Check ☐ _____

Handling and shipping charges extra. Approx. 30 days delivery from Gardner, Mass. All chairs delivered in Mass. must be prepaid. Make checks payable to the Harvard Cooperative Society. Massachusetts residents: Please add 3% Mass. sales tax. (Out of state residents: No tax except when delivered in Mass.) Prices subject to change without notice.

TR-71

Concerned that traditional academic ceremony spoke to a university image that may not be appropriate to an institute of technology in the last years of the 20th century, the committee charged with planning the inauguration this fall for Jerome Bert Wiesner as M.I.T.'s 13th President went a different way. For two weeks in September and October the Institute was preoccupied with a series of events designed to show its present and future commitment through technology to economic, social, and environmental issues. There followed a much simplified inaugural convocation at which Dr. Wiesner delivered the address published on pages 14-19 and his long-time friend Archibald MacLeish read his "Speech on a Public Occasion" (opposite). The emotional moment of the ceremony is captured in this photograph by Robert Lyon when Dr. Wiesner, turning from the ovation he received as he took custody of the Charter of the Institute, embraced his long-time friend.

SPEECH ON A PUBLIC OCCASION

for Jerome Wiesner

Rinsing our mouths with praise . . .

Tin cup,
by the limestone spring in the cool of the mintbed.

Earlier generations knew this place,
made their way here thronging. We have forgotten it:
we have kept to the streets too long, tongues
stale, hearts thirsty.
Oh, to praise!
God's will in the world if we could learn it,
test it on our lips, would taste of praise.
Why else should the world be beautiful? Why should the
leaves look as they do, the light, the water?

Rinsing our mouths with praise of a good man . . .

I say what I mean. I do not say
a good man in a bad time.
All times are bad when the man fails them.
I say:
a good man in a time when men are
scarce, when the intelligent foregather,
follow each other around in the fog like sheep,
bleat in the rain, complain
because Godot never comes; because
the whole thing is a tragic absurdity – Sisyphus
sweating away at his rock and the rock
won't; because freedom and dignity . . .

Weep, they say, for freedom and dignity!
You're not free: it's your grandfather's itch you're scratching.
You have no dignity: you're not a man.
You're a rat in a vat of rewards and punishments.
You think you've chosen the rewards: you haven't.
The rewards have chosen you.
Aye, weep!

Rinsing our mouths with praise of a good man
in a time when men are scarce, when the Word
chirps like a cricket on the cellar floor,
on the damp stones – when the mind moulders . . .

A good man!
Look at him there against the fog!
He saunters along to his place in the world's weather,
hitches his pants, lights his pipe,
talks back to accepted opinion.

Congressional Committees hear him say:
"Not what you think: what you haven't thought of."

He addresses Presidents. He says:
"Governments even now still have to govern.
No one is going to invent a self-governing holocaust."

The Pentagon receives his views:
"Science," he says, "is no substitute for thought.
Miracle drugs perhaps: not miracle wars."

Advisor to Presidents, the papers call him.
Advisor, I say, to the young.
It's the young who need competent friends, bold companions,
honest men who won't run out –
won't write off mankind, sell up the country,
quit the venture, jibe the ship.

I love this man. I rinse my mouth with his praise
in a frightened time. The taste in the cup is of mint,
of spring water.

Archibald MacLeish
October 7, 1971

In his inaugural address, the 13th President of M.I.T. suggests how there may occur a renaissance in which man replaces machine at the center of the stage.

Science, Technology, and the Quality of Life

Jerome B. Wiesner
President of M.I.T.

Times are no longer conducive to speculation. Our burden is that we know enough today to make dire, and specific, predictions about the future—and most of us will live to see some of them come true. Nor do the times call for purely expedient commitments to action. We have all memorized the words of ten years ago which conjured visions of great new worlds; our need now is to move practically and painstakingly toward their fulfillment. Our commitment must be to progress in significant and inspiring steps toward solving our local and global problems. In the pursuit of these tasks we cannot afford cliches, and a failure to examine and re-examine ideas will amount to a betrayal of the human race.

In this context I wish to restate what I see as the basic purpose of any university and of ours in particular: It is the quest for learning, the nurture of learning, the transmission of learning, the use of learning. We gather at such institutions, teachers and students alike, to expand man's knowledge of his universe. No doctrine, no orthodoxy, no conventional discipline or gust of political passion can be allowed to divert us from this purpose.

When this university was founded a century ago, the atom was an irreducible unit, radiation was not understood, the great equations that frame the physical universe were undreamed of; Pasteur was just beginning his work, Einstein was unborn, the moon was made of green cheese. As much as any institution of learning in the entire world, M.I.T. has helped roll back the frontiers of darkness. And we shall continue. Here we shall offer shelter for the search for knowledge to all those who come, at any age, to join in that search. And the only loyalty test we shall impose is that of loyalty to learning.

In this spirit the faculty and alumni of M.I.T. have earned us an honored place among the world's great universities. The social and behavioral sciences, management, humanities, and the creative arts have taken their place alongside the original activities in science and the "useful arts" (as William Barton Rogers, M.I.T.'s founder, used to call them), adding substantially to M.I.T.'s intellectual breadth and distinction and to its record in public service.

Much of what we do in the year 1971 must reflect the uncertain mood of the times and highlight the necessity for re-emphasizing the great excitement and essential value of research in the sciences. Our agenda also reflects deep awareness of the threats to the quality of life in our society and the need for increased sensitivity to the dangers arising from the careless exploitation of new technology.

The Essence of an Enigma

I have been impressed, since being appointed President, by the great concern and affection of people I meet everywhere for the welfare of M.I.T. and for universities in general. The hidden message I decode is that a lot of people, including many with no ties to the academic world, do care about the universities, do look to them for leadership and, consequently, are very upset when they find their performance disappointing. But I also hear much criticism of M.I.T. specifically, as well as of other universities. The criticism comes from everywhere, old and young, rich and poor, radical and conservative, from all ethnic and minority groups.

For each group the university is the symbol of its frustrations and fears. The reactionary elements in the society are prone to view the university as a subversive force and believe that its administrators have been too tolerant of student and faculty challenges—some say threats—to the established order. Large numbers of young people and those adults who want more rapid social reform are critical because they consider the university a conservative force whose primary function is to "socialize"—in their words, "co-opt"—students for a role in society which they see as exploitive, unsatisfying, and—to varying degrees—obsolete and designed to support existing institutions and social relationships. We have achieved the dubious distinction of being regarded, at one and the same time, as the hothouse of revolution and the propagator of the status quo. To the poor and the blacks, the university is the locked gateway to opportunity. And other critics see the university as an untrustworthy ally whose staffs use knowledge sought at public expense to frustrate government purpose.

In other words, to many citizens of our society, the university has become the essence of the enigma that is the future; in it are fused the hopes and disappointments that power the continuing revolution of our times. Academia, with its conflicting constituencies,

"... I am convinced that without new scientific knowledge and wise technological investments now and in the future, the problems of mankind will only increase.... I view the present multi-crisis ... as a perilous but positive phase in man's continuing evolution—a process now determined largely by his own actions, which he is still learning to manage."

is at once the intellectual front line and the only neutral meeting ground of that revolution.

The many individual objections to the performance of universities are given coherence and are amplified by a growing wave of anti-intellectualism, mysticism and primitivism. This new evangelism is fostered by those who feel that the structure and goals of a society which stresses the achievement of material progress through science and technology cannot provide a life of dignity for the individual. For these critics, including many students and faculty, the university is in league with the enemy; for some it is the enemy. And to those who see uncontrolled technology as the major source of our social dislocations, M.I.T. is the special symbol of concerns and frequently the object of anger. They are persuaded that the social and economic forces which propel technological innovation cannot be directed toward the general welfare; that, in fact, technology represents a malignancy which will dominate our civilization and ultimately condemn all men to be slaves of a vast, impersonal, and all-powerful organization. Their cry is that its onslaught must be stopped.

If this vision is correct we are already doomed; for it is clear to me that we cannot escape technology in some form. In fact, I am convinced that without new scientific knowledge and wise technological investments now and in the future, the problems of mankind will only increase. At the same time the increasing complexity of society and its capability for control of the individual pose very real hazards, and these matters require our continuous vigilance.

I view the present multi-crisis differently—and hopefully. I see it as a perilous but positive phase in man's continuing evolution—a process now determined largely by his own actions, which he is still learning to manage. At this juncture, it is our obligation to intervene on the side of man. Ironically, the problems we face stem from our success—from efforts to achieve equality and a decent life for all citizens.

Social Feedback at Work

Science and technology have helped create our present predicament by extending to most of us options in modes of living and working that were previously reserved for a privileged few. For too long we have been totally hypnotized by what we could do. Until recently, people in the "advanced countries," as we like to call ourselves, have assumed that any application of technology that expanded mastery over nature was desirable, and we have ignored the implications of this power. Rarely before this decade was the relationship between technological change and man's social, biological, and physical environments examined; only obvious benefits were considered, and only immediate costs. Little consideration was given to the "ecological" dimensions of innovations—physical, social, or psychological. It is precisely the chasm between our tremendous power to change and our apparent inability to guide these changes for the good of mankind that has led to the feeling of desperation and the loss of confidence in the scientific approach.

But if we look at recent events with some detachment, we can see some positive responses to these problems. The social feedback systems are working.

Not long ago the environmental hazards were recognized by only a few experts whose warnings were completely disregarded. I recall how violently Rachel Carson was attacked in 1961 for her statements about the deadly consequences of the indiscriminate use of pesticides, and a panel established merely to look into her allegations was strongly criticized. The use of many of the chemicals she warned against is now prohibited. Likewise only a decade ago man-made radioactive poison fell from the sky with every rain, doing incalculable damage to living beings everywhere on the planet and jeopardizing hundreds of future generations. The nuclear test-ban treaty of 1963 almost completely stopped that poisoning of the atmosphere.

Today, protecting and improving the quality of the environment is a major national goal which almost everyone accepts and is prepared to pay for, and the human, social, scientific, and political issues involved are receiving concerted academic study.

Another major response to current dissatisfactions with the status quo was that mounted by the country's educational system. As I think of it, it has been the most massive reaction in my memory to a social crisis. At all levels and in every kind of school we see new programs and experimentation, a reaching upward in a continuing search for a "better," more engaging and significant

education. However, the good intentions unfortunately —to date—outrun the accomplishments.

A Renaissance: Man Replacing Machine

Nowhere, I believe, is the fervor for educational innovation and for undertaking inquiries into society's many needs greater than here at M.I.T. And an important reason for this educational ferment has been the students themselves. They are knowledgeable, and they are mature. They insist upon a chance to think about who they are and why they are doing what they are doing and where they are going. They want to develop broadly in all spheres—moral, social, intellectual and political—and they do not want their lives compartmentalized. They are eager to work hard and anxious to learn, but only in connection with a faculty and an institution that they can respect for its values, its commitment to society, and its attention to the individual. To a far greater degree than his counterpart of a decade ago, today's student contemplates a career in some part of the public sector or in an industry that is oriented to social responsibility. This is indeed a heartening sign.

We have begun to break the academic lockstep—to make it possible for a student to learn in a style that suits him, at a pace that he chooses, with the freedom to tailor his own academic program. The project laboratory, the seminars, the undergraduate research involvement, the Experimental Studies Group, the Unified Science Studies Program—all add new dimensions to undergraduate educational opportunities. These accomplishments have been accompanied by the development of a deep and sustained interest on the part of students and faculty in the educational process itself as a discipline worthy of investigation and study, in which are joined a regard for subject matter, a broad knowledge of human beings, and an appreciation of the possibilities of technology.

There is still much to learn. How can M.I.T.—any university—more fully engage the outstanding young people it attracts? How can it help them discover themselves? How can it organize its programs and utilize the promising new technologies to permit faculty members to spend more of their time and efforts in direct relationships with students? How can M.I.T. make effective use of the educational potential in industry and government? How can it respond to the hopes of many alumni for a more intimate and productive association with the Institute through periodically renewed contacts for learning? And how would such continuing educational programs alter the time and substance of the formal university experience?

This is a unique moment to pause and re-examine our educational policies, for the walls of the professional departments—especially in engineering, architecture, and urban studies—are breaking down to make room for the evolution of new unities. Professional faculties and their students are reaching out to the society—the neighboring community, government, and industry—in order to make a conscious contribution, through understanding and action, in the fields of environment, health, urban studies, architecture, educational innovation, and international understanding, and in the management of science and technology itself.

This movement can stimulate a renaissance among the professions in which man will replace machine at the center of the stage. New cooperative ventures involving the social sciences and humanities should draw disparate disciplines closely together and in so doing provide opportunities to create exciting new forms of professional education. Thus—by integrating science and technology with the study of man and his culture—can we recast the concept of a liberal education in a contemporary mold. Perhaps then, too, the history and philosophy of science and technology will become a significant aspect of humanistic studies.

Midcourse Guidance: Toward Integration

Last year William Arrowsmith, the classics scholar turned educational innovator, surveyed the spreading dissatisfaction within liberal arts institutions and responded with a not-dissimilar vision of a new educational synthesis flowing from the impact of current social turmoil on the professions.

He said: "We have integrated problems and disintegrated skills. And the alienation of knowledge and the liberal arts from the crisis of the professions is no longer a tolerable luxury. If the liberal arts attempt to maintain their traditional aloofness, their devotion to pure research and contemplation, their subject matters will simply be appropriated. The professionals have no alternative; they are too close to society, to the convulsive chaos around us, to escape responsibility for change, for rational and humane action." And he went on to say: "The professions, I am suggesting, have encountered the 'other;' a new humanism is already taking shape among younger professionals in response to the desperation of those who depend upon the professions. And because the professions cannot do without the arts of knowledge and the liberal arts, their encounter will eventually spread to education too."

Twenty-two years ago a faculty committee of which Julius A. Stratton and I were members concluded its recommendations with the hope that "the Institute may become known as a place where the professional training and the general education necessary for professional leadership are integrated." To assist in achieving this goal, the committee recommended the establishment of M.I.T.'s School of Humanities and Social Sciences. Though the school has become a most distinguished and vital component of the Institute, the integrated education we dreamed of did not emerge. Partly this was because the goals were not clearly articulated, certainly not generally understood, perhaps ahead of their time, not even quite believed in, perhaps even impossible. Perhaps we failed to appreciate the difficulty of the task—it is easier to teach facts and problem-solving skills than to teach the expressive and appreciative skills. Despite the fact that some of these objectives have eluded our grasp, we know that we have great strengths in the School to support our new initiatives. What I have explored here today is in the nature of midcourse guidance for our academic flying machine.

Campus and Community

As I close, I would remind us of our immediate opportunities to enhance the quality of life close to home—on the campus and in the neighboring community.

"Our country presently is full of public mourners, of dour analysts of the future. I do not count myself among them. . . . For those of us who see problems as challenges, these times may be one of the rare opportunities in history when men of our kind may contribute their most."

First, to make careers in science and engineering more attractive and accessible for members of minority groups and women, through opportunities as students, faculty and staff employees at M.I.T.

Second, to contribute through our actions and support to the well being of the community in which we live.

Third, to seek new ways of collaboration with our sister institutions of the area. Our joint programs with Harvard University, Wellesley College and the Woods Hole Oceanographic Institution already play a major role in the lives of many students and faculty, both through collaboration and the sharing of resources. The interchange of students and faculty enriches far beyond the scholarly opportunities thus provided.

Lastly, charity, they say, begins at home, and we must remain committed, in spite of severe fiscal constraints, to continue our recent efforts to improve the quality of the campus environment.

Toward a Future as Brilliant as the Past

Now, let me recapitulate the thread of my thoughts. Our first responsibility, as I have said, is to learning itself. Our second responsibility, since ours is the world's foremost institute of technology, is to understand what our learning and discoveries may do to man and society, and to transmit that knowledge to new generations—to men and leaders who may be wiser than we in applying it, or wiser in judging how slowly or rapidly these technologies may be absorbed.

I conclude with a humility forced on me by the contemplation of my own experience and the experience of our country in these times, with the realization that our central problem is man himself. If, through our quest for learning, we can help develop wise men; if, by our research and study, we can deliver leaders trained in the study of nature's evidence and nature's promise; if we can shape young people who are fully aware of their own powers of mind, who have the courage to stand alone; who are committed to justice and to humanity, people modest enough to know that men trained in other disciplines may understand America as well as they—if we can do all this, then M.I.T. may face a future as glowing as its past.

As an institution within a larger community, we must respond to national needs. We hope to educate men and women here who will help, when they leave and as they mature, to define what those national needs are—who will work, not as elitist specialists but as individuals, among 200 million Americans, to bring about the necessary improvements in our society.

Our country presently is full of public mourners, of dour analysts of the future. I do not count myself among them. The times are hard today; no one would see this as a moment ripe with the full flowering of the American spirit. Yet the times have always been hard for men who seek to change, whose occupation and calling is the forecasting and the fostering of change. For those of us who see problems as challenges, these times may be one of the rare opportunities in history when men of our kind may contribute their most. I am thankful to have, at my side, one of those men, Paul Gray, my long-time colleague, as Chancellor. I take pride in this new opportunity; I am hopeful for what lies before this community; I rejoice in the adventure which, all together, we can look forward to sharing.

Many years ago Mr. MacLeish suggested that civilization would not be healed until people could see and know feelingly. His words should ring in our memories as we go about our tasks, and if he will excuse my presuming this once to invade his craft I will conclude thus:

No equation can divine the quality of life,
no instrument record,
no computer conceive it.
Only bit by bit can feeling men
lovingly retrieve it.

Though this may be a time of peril for university presidents, Jerome B. Wiesner showed no panic upon receiving the Charter of the Massachusetts Institute of Technology from Howard W. Johnson, Chairman of the M.I.T. Corporation, on October 7. With them on the platform for the inauguration ceremonies (picture, p. 14) were in the front row (left to right) James R. Killian, Jr., Honorary Chairman of the Corporation; Julius A. Stratton, President Emeritus of the Institute; Paul E. Gray, Chancellor; and Vannevar Bush, former Honorary Chairman; and in the back row Robert N. Schulte, President of the M.I.T. Undergraduate Association; Alfred E. Vellucci, Mayor of Cambridge; Walter A. Rosenblith, Provost; Archibald MacLeish; Hartley Rogers, Jr., Chairman of the Faculty; Paul E. Keyser, Jr., President of the Alumni Association; and William M. Mack, Jr., President of the Graduate Student Council. (Photo above: Alfred I. Anderson, 3d)

Usually remembered as a soldier, Napoleon also exemplifies inventiveness in civil institution-building. As First Consul, he undertook a systematic assessment and reorganization of the institutions of France: the Code Napoleon *redefined the laws and institutions of personal status and is the basis of the French legal system today. France is still governed—and educated—by the institutions which Napoleon established in the wake of the French Enlightenment's rigorous critical assessment of the fabric of feudalism. Dr. Davidson argues the continuing importance of this kind of work: it is necessary, he says, "to monitor institutions with the same candor with which we assess the quality of water and of air."*

Attempting to apply technology to the major national and social tasks, many workers have encountered very obdurate problems which they describe as institutional rather than technological. It is here argued that the assessment and design of institutions is a discipline in its own right.

Frank P. Davidson
Visiting Lecturer
in Mechanical Engineering, M.I.T.

The Case for Institutional Assessment

The planet and the country are presumed by many to be in deep deep trouble, and scarcely a day goes by without the formation of some new research institute or governmental commission designed to cope "more effectively" with the baffling problems of modern society. Technology, of course, is a fashionable whipping-boy; "technology assessment" has understandably won substantial acceptance as an appropriate and necessary response. And there is a widespread feeling that the very advanced technologies we have—notably, in aerospace—should somehow be applicable to our most worrisome problems.

The high-technology industries have in fact been trying to help. Their predicament in this matter was recently stated very succinctly by Dr. Morris A. Steinberg, deputy chief scientist of the Lockheed Aircraft Corporation, in one of the "Los Angeles Decarama" lectures at U.C.L.A. He told of Lockheed's attempts to "harness aerospace skills to the solving of domestic problems"—in particular, the problems where such skills seemed most likely to be useful, namely aerospace, communications, water systems and regional development. "Many aerospace organizations," he said, "have considered and taken actions in these areas for a number of years—and have had some unhappy and expensive experiences in them . . . The problems we encountered—and, I can say confidently, the problems the other corporations have encountered—have nothing to do with any lack of technology or of sustained and serious effort."

Dr. Steinberg summed it up thus: "The problem is simply that the market for these activities either does not exist at all, or if it does, it is so highly fragmented that it can be cultivated only at costs too great for any private organization under the present circumstances."

The barrier to action which Dr. Steinberg defined indicates a serious shortcoming in the working institutions of our society—the institutions whose purpose is to connect our resources to the real tasks in hand. If the reorientation of technology and a host of other urgent tasks are to be undertaken with a prospect of more than superficial accomplishment, we must henceforth be very much less vague in our condemnation of established institutions. What I am suggesting is that *institutional assessment* must be recognized as a legitimate and continuing need of the constitutional process.

Consider, to begin with, the simplest and biggest of our institutional problems:

To pay for programs in education, pollution control, transport development, and others, seems to require massive infusions of funds from the "private sector," because no other budgets are adequate. But neither conservatives nor liberals have fully confronted the philosophical and procedural necessities of such a financing program. "Venture capital" cannot be lured into situations of high risk and low rewards. Nor should institutional investors be invited to take unreasonable risks with other people's money. So how is the needed funding to be arranged?

I believe this particular problem is solvable, and I shall return to it later. Take it, for the moment, as an example of an institutional obstacle. To remove such obstacles, we shall have to monitor institutions with the same candor with which we assess the quality of water and of air.

The United States finds itself in a curious position. At a time when social and environmental problems require collaboration on a vast scale, we are hobbled by concepts and institutions shaped by the quite different preoccupations of the 19th century. Our very successes have prevented us from undertaking such "agonizing re-appraisals" as underlie the impressive post-war resurgence of Europe and Japan. Adversary attitudes, and agencies derived from the days of the "trust-busters," inhibit consultation and cooperation between public bodies and private institutions which are destined to share the future of our polity. And where widespread agreement does exist as to what should be done, we are still, too often, unable to put our thinking into action. Which raises the question of what kind of thinking has been going on, that ends in the writing of unfillable prescriptions.

Feasibility

The responsible student and citizen, in considering any recommended course of action, must ask himself in every case whether the "preferred" course is feasible, and where are the resources for its achievement. One may ask, Is this not always done? Is not every major project preceded by a round of feasibility studies? Well, appearances can be deceptive. To an extent not sufficiently realized, this whole area of feasibility represents

an institutional and methodological no-man's-land of substantial dimensions.

Part of the trouble is semantic. "Feasibility studies" are an instance of the institutional confusion which can follow imprecision in concept and in language—confusion which in this case has proliferated to such an extent that it has hampered the effort to bring "technology assessment" into useful relationship with financial, political, and legal realities.

That the "feasibility study" is part of the normal stock-in-trade of consulting engineers, management consultants, and research institutes confounds the problem by making it appear that this necessary function is actually being taken care of. Government agencies and major corporations spend millions of dollars per month in such exercises—but to what end? Major societal choices are at issue, but the results would hardly lead one to think so.

The "feasibility study" of a given program characteristically sets out to accumulate and summarize evidence as to what various third parties (government agencies or bankers, for instance) will or should do by way of cooperating with the program; the evidence is sifted and weighed and a judgment is expressed as to the practical possibilities of realizing the program from financial, technical, legal, and other viewpoints. This assessment of feasibility is a major component of the process leading to "decision" (pro or con).

But it is common knowledge not only that the overwhelming majority of recommended programs are not implemented, but that they often lack proper preparation from the standpoints of legal and financial analysis. It would appear that these feasibility assessments are often overridden or ignored entirely—usually, it seems, out of lack of faith in their reliability. Why is this so?

To some extent it is because the engineering profession has allowed itself to be employed in making judgments for which the engineer is neither trained nor qualified. Economists and management specialists have also, to a degree, fallen into this trap of consenting to issue *pronunciamentos* on matters beyond their knowledge and scope.

New ground-rules are needed to restore the idea of the "feasibility study" to a semblance of semantic accuracy. If the project under review is one involving the authorization, financing and construction of a major structure, the client would be well advised to call together a "feasibility team," inter-disciplinary and inter-professional. To request an engineer to assess the adequacy of legal and financial arrangements is as "unprofessional" as to require a lawyer to calculate the permissible stresses on a bridge. If, nonetheless (perhaps because of contractual arrangements governing a survey), an engineer must prepare a "financial plan," would it not be the better part of modesty and wisdom to have it reviewed (prior to publication!) by a banker whose firm is capable of underwriting the investment? Likewise, where official action of some sort is required, is it not advisable to touch base with the official or agency involved, in order to obtain a truly realistic view of the likelihood that the desired action can be obtained (and—if it can—under what terms and conditions)?

Busy bankers and officials are not generally thought of as "consultants." But the provision of financial advice is in fact a normal and traditional banking function. And taxpayers have every right to expect that government officials will participate in the early consideration of programs expressly designed to serve the public interest. Where legal issues are involved, it may even be useful to consult a lawyer! The simple procedure of asking people to furnish advice on matters within their competence would, if adhered to, avoid a great deal of waste motion and waste paper.

There are practical as well as ethical aspects to such consultations. If the first that a busy "decision-maker" sees of some major proposal is a 300-page "feasibility study," he may be forgiven if his immediate reaction is one of dismay. Rather than wade through the exhaustive and exhausting footnotes, tabulations, and summaries, he may prefer to glance at the name of the report's author. If the signatory is not an individual or a firm well and favorably known to the person asked to stake his money or reputation on the recommendations, then it cannot cause utter surprise if the recommendations do not carry great weight with the "decision-maker"—who may be viewed with compassion if he does not, in such cases, produce the desired "positive" response.

All concerned will benefit if the initiator of a program, at the outset, calls on those who must authorize and finance it: the purpose is to make sure that one's chosen "experts" are indeed regarded as experts by the people expected to read their reports and concur with their assessments and recommendations. If "participation" makes sense at the lower rungs of the hierarchical ladder (and I believe it does), then in fairness it should be extended to the often-overworked individuals at the top, who, no matter how elevated, usually appreciate the opportunity to hear of a project at its inception and to participate in some of the key decisions during the course of investigation and appraisal.

"Feasibility studies" have too often been regarded merely as an ancillary service, an aspect of a forecast of the results to be expected from an imagined decision. Genuine investigation of feasibility is in fact a key step in the process of decision itself. A project does not become feasible because someone has predicted that it will be; it is *made* feasible by the actual willingness of individuals and organizations to undertake binding commitments (on the basis of, among other things, such predictions). A feasibility forecast is valuable in so far as it reduces the scope of uncertainty and facilitates commitment. A program is feasible only to the degree that the forecast can be supplemented or supplanted by the judgment of parties who will themselves assume the risks of decision. Real feasibility, except in a very restricted sense, cannot be "assessed" by "experts" at all.

This line of reasoning concerning procedure leads to a

recommendation concerning structure. It implies that the "study group" of the future will not only include a group of research specialists regarded as "experts" (i.e., people who do not have to live with the impacts of their recommendations) but will also include the very persons whose authorizations are indispensable if the program is to go forward.

Thus far we have considered, from the viewpoint of the proponent of an innovation, the reasons why research results are so often neglected. But now consider the same situation from the viewpoint of the "decision-maker." He is himself a victim of the organization which prepares and defines his options—some of which, at least, he approves. Approval is generally no better justified than rejection. The head of a busy department in any major city is apt to spend so much time signing documents and performing other routine chores that he has very little time for questioning the data or the values and goals implicit in the documents with which he is constantly confronted. Should he wish to make a decision *en pleine connaissance de cause,* he must first find a way to collaborate with his staff before the contracts and speeches are prepared in final form for signature. This does not usually happen. The true power of decision—when the decision is positive—as often as not lies in the processes vaguely described as "research" or "advice." If an *éminence grise* was the true power in the France of Richelieu, how much more diffuse is the decision process in a complex technological society such as ours?

Combining Knowledge and Power

Thus analysis and decision, rightly done, are highly interactive, the former taking into account genuinely probable outcomes of the latter. Wrongly done, they are still interactive, the analysts having a decisive influence, very often, which they never intended. The present exaggerated separation of institutions of research and assessment from institutions of implementation introduces a note of unreality and disfunction into the social process. Need they be separated thus?

Corporations and government agencies, generally regarded as institutions that "get things done," are after all not so different in nature from universities and research laboratories. Indeed, our various institutions resemble each other far more closely than their stereotypes would suggest. And modern communications and transport technologies give us access to a common body of information—and to each other. Perhaps it is time to recognize the obvious and to actively engineer the intimate collaboration of people in different circumstances who share a common and over-riding interest in the survival of the species. Perhaps it is time to get away from the exaggerated purity of the think-tank and attempt that synergistic mixture of knowledge and power, of "thinkers" and "decision-makers," which Harold Lasswell calls "the decision seminar."

The change in style ought to be welcome. We have seen the "knowledge revolution" trumpeted precisely at the time universities and research institutes were about to face their worst drought. Apparently Bacon's aphorism, "Knowledge is Power," cannot be applied indiscriminately! Sobered by the news that commercial banks, in contrast to universities, have recently reported their "highest earnings ever," more intellectuals may now be willing to probe the life-styles of the denizens of Wall Street and the City. No doubt some bankers will continue to complain about ivory-tower theorists. But an alliance between socio-technological research and (public and private) investment banking would bear the authentic hallmark of mutual convenience and necessity.

Such an alliance could contribute to the removal of the institutional impasse which was mentioned at the start of this article, and which went thus: Government budgets will be insufficient to meet the burgeoning requirements of social research and improvement (even supposing early disengagement from Indo-China). So private funding is needed. But it will not be forthcoming for purposes that offer high risk and little reward: if large public-benefit programs are to attract the confidence of the capital markets, there will have to be demonstrable opportunities for security and profit.

The way out of this trap is to be found not in particular actions but in institutions with particular abilities. We require not only a multitude of mixed-economy corporations such as COMSAT but also the sophisticated use of an array of security devices such as guarantees, throughput agreements, and long-term leases. Further, where government jurisdictions have been outmoded by the march of events ("a series of memorials to old problems," as Donald Schon called government agencies in the February, 1971, issue of this journal) new authorities, commissions, and other bodies will have to be designed and legislated into existence. And above all, well-managed research programs will be needed to reassure the public that approved intersectoral investments will in fact contribute to preserving or improving the quality of life.

When I.B.M. underwrote the Harvard University Program on Technology and Society, there was an implicit assumption that technology had done something to society; but the slow discovery that the problems of urban man are infinitely complex has exploded this "devil theory" of our social ills—without providing the methodological comfort of a countervailing theology. Merely pronouncing a technology "bad" does not, it is now realized, lead to its replacement with one that is "good" unless institutional processes (including the supplying of really adequate money) are set in motion. Lawyers, political scientists and publicists are finding, to their delight, that their wares are again saleable: socio-technological systems are seen to be heavy on the "socio"; control of the side-effects of technology is seen to entail a realignment of power and responsibility. In a word, technology has become too important to be left to technologists alone.

While it may be the better part of academic valor to render the simple complex, a single illustration goes to the root of the matter: the case of automobile pollution. Many people (including the manufacturers) agree that present engines are "bad." It appears to follow that a market exists for a "good" engine. But does it? Potentially, yes; but the "good car business" will not materialize automatically. To bring it into

being we require the kind of initiative that would have State X say that, commencing January 1, 1973, it will buy only cars that meet certain standards and that the State therefore agrees to buy 10,000 such cars at a price of $5,000 per car during the ensuing five-year period. The resulting availability of $50 million would inspire a series of offers to design and build a vehicle of the desired description, together with its ancillary systems.

The fault in this example is that it does not require any intellectually difficult institution-building: just a contractual undertaking to buy future goods meeting certain requirements. But the example is instructive, if only because it shows that our ideas of "market analysis" sometimes lean too heavily on forecasting and statistics and neglect the key question of the relationship between forecasting the future and engineering it; while at the same time our notions of technical change tend to neglect the non-engineering corollaries.

An Institutional Decade?

The university, the research institute, the corporation, and the government agency are all feeling the pressures of new technologies and of the institutional criticisms which, explicitly or implicitly, have arisen as a result. But the structured look at all this is missing. A major intellectual campaign is needed if we are to remove the real obstacles to effective action: sustained policies cannot be put into practice without appropriate organization.

When a state like Massachusetts must contemplate a $1-billion annual welfare budget, it is clear that a major effort must be made to achieve a better comprehension of the dynamics of the systems which have given rise to our dilemmas. If we cannot even find out how we got to where we are, it may not prove too easy to find out how to get to where we want to be.

That the task of understanding our institutions and devising real improvements is immense and complex is no excuse for ignoring it. One hopes that some interdisciplinary body such as the American Academy of Arts and Sciences will consider an extended program to outline the problem and to suggest methods of organizing the analysis. A Commission on Institutional Assessment would be a logical follow-on to the Commission on the Year 2000. The latter could be used as a source of realistic baselines for the more pedestrian sequel which it deserves. (The year 2000 seems, in these days of successful cloud-seeding, to be taking over the conversational function of the weather: everyone talks about it, but nobody does anything about it.)

Coupled with increased support for study of the underlying system dynamics of our society, a "decade" of institutional assessment might well lead us not only to a reform of our institutions but to a better knowledge of ourselves. But it must not be another academic exercise in detached research. We must, from the start, involve people from the various sectors of society whose cooperation will be needed if there is to be any practical application of the new institutional understanding we attain (rather than confronting the public with finished expert prescriptions and expecting them to accept our proposed institutions as laws of nature).

Work in Progress

Having gone this far, is it possible—without in any way prejudicing the tendencies which institutional assessment teams may adopt in the future—to presage some of the institutions which may crop up as resources are redeployed into areas of urgent concern? I think we can at least suggest *areas* where institution-building will occur.

In the field of education, the highly respected International Institute for Educational Planning has published in *Management and Decision-Making in Educational Planning*, I.I.E.P., UNESCO, p. 30) a "flow chart for institutional assessment and innovation" (*see figure*). The Institute on Man and Science took an important initiative in calling together, during July, 1970, the organizations which, if they can define and collaborate on a common program, might be able to influence the future of Lake Erie. Another hopeful sign is that the responsible heads of the National Academy of Sciences (U.S.) and the Canadian Research Council are collaborating in a series of informal meetings around the same theme. More forums are needed where, without constricting agenda, the individuals with leverage on a problem can meet to discuss objectives and strategies.

In the next few years we shall see discussions of the feasibility of setting up scores of new financial institutions combining the capabilities of public and private investment. Banks for educational development, for transport finance, for specific environmental programs (a Bank for the Restoration of the Great Lakes, perhaps?), are bound to be given serious consideration, as the realization spreads that entirely new approaches are needed if money is to be provided for programs that nearly everyone wants.

Along with new financial institutions, we shall be witnessing the birth of a host of innovative research organizations designed to prepare and monitor investment programs of exceptionally large dimensions. M.I.T.'s Urban Systems Laboratory, in its services to the Geo-Transport Foundation of New England, Inc., has pioneered new ground in marshalling intersectoral support for the analysis of schemes designed to bring to the region a modern, high-speed rail passenger service.

The evident wastage of resources implicit in the present haphazard competition between ground and air modes suggests the need for a new ethos in the transport industry and perhaps for the eventual establishment of a Graduate School of Transportation Science. One can already discern the appeal of a Transport Systems Evaluation Laboratory as an independent, authoritative source of guidance towards systems that combine the best features of the various modes of transportation.

Just as the military services have had to contemplate institutional changes to overcome the parochial loyalties of Army, Navy, and Air Force, so civilian agencies —public and private—must not shrink from founding

new schools and research centers when, in the general interest, an "overview" is required.

I have said that from many points of view a bank is not so dissimilar from a "think tank." The distinction fades almost entirely when one looks at such proposals as David Rockefeller's recent advocacy of a special financial institution to fund the establishment of new towns. In this case, a banker (who happens to have a Ph.D.) has appealed for the support of intellectuals and public officials, and indeed of all other interested elements, in a concerted effort to launch a major intersectoral program. The parallel recommendation of a governmental "land bank" to facilitate wise selection of land (and prevent land-value speculation) deserves equally serious consideration. Should there not be a genuine meeting of academic, governmental and private interests to pick up the ball and examine the implications of Dr. Rockefeller's suggestions just as if they proceeded from one of those institutions which are supposed to specialize in "thinking"?

We have already considered the restructuring of feasibility-study procedures; we must to an extent restructure the organization of advice, by adding to the notion of "interdisciplinary" work (which still encounters neanderthal resistance here and there) the notion of the *interprofessional* team. The "knowledge revolution" could be sterile if it is confined within the traditional mandarinates of university and research institute. The Nazis, as we may usefully remind ourselves, succeeded in winning power in the most highly educated country in Europe.

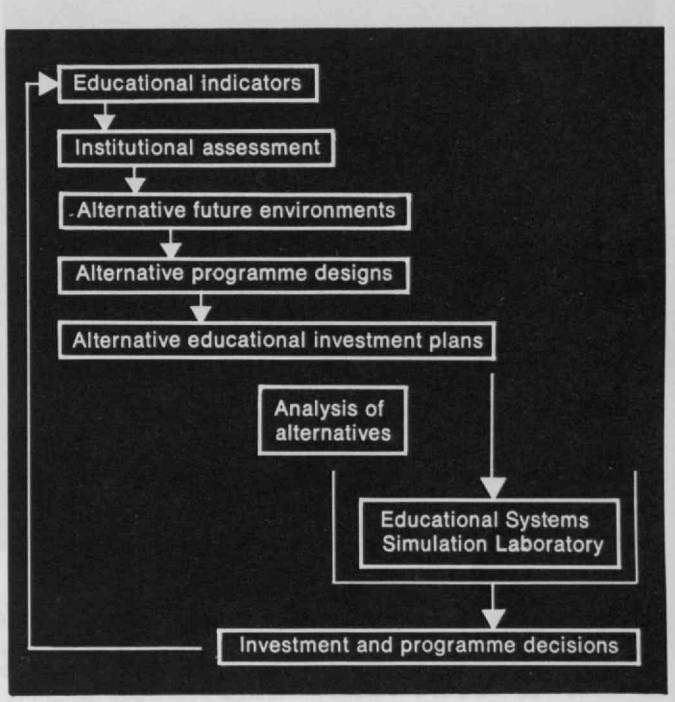
I suspect that the realization of the "réforme des structures" (as Louis Armand has called it) will be most effectively brought about by the efforts of ad hoc groups of academic and non-academic people: the close association at M.I.T. of Professor Jay W. Forrester and Mayor John F. Collins may be said to prefigure the future setting of socio-technological research.

Macro-Engineering

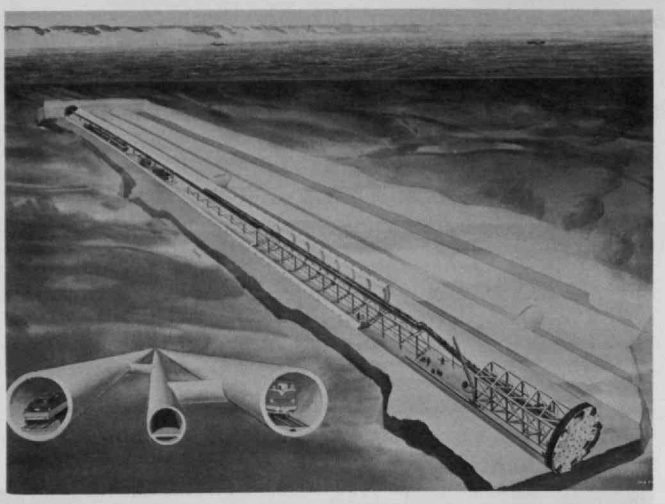
Once goals are assessed and selected, and their feasibility determined, we confront the strategic problem of properly marshalling resources to accomplish concrete programs and projects—in a word, "macro-engineering." Our society, which produced the Manhattan Project and the Apollo Program, must now learn how to choose and carry out equally vast undertakings on an *intersectoral* basis.

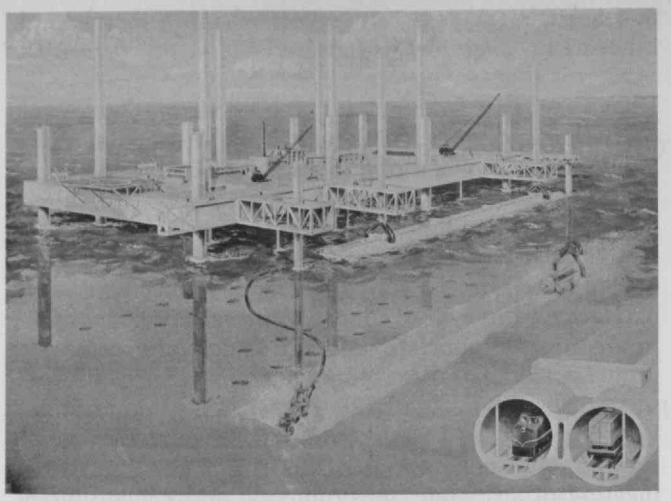
Even in the domain of space, private investment is beginning to demonstrate its inherent advantages of flexibility and resilience; with respect to earth-resource survey satellites, there exists a convincing institutional assessment of the appropriate roles of public and private ownership (A.I.A.A. Paper No. 70-334, *Potential Institutional Arrangements of Organizations Involved in the Exploitation of Remotely Sensed Earth Resources Data*, by T. J. Gordon and S. Enzer of the Institute for the Future).

European undertakings such as the Channel Tunnel Study Group can serve to an extent as models for more homely joint endeavors of technologists, lawyers, gov-



This "flow chart for institutional assessment and innovation" has been put forward in a publication of the International Institute for Educational Planning (see facing page).





Originally proposed in 1751, an undersea link between England and France could have been financed and built more than a century ago. But not until the Channel Tunnel Study Group provided the institutional mechanism for cooperation by public and private financial agencies could this project—seemingly a purely engineering matter—be given the green light.

As to the engineering, there are two major techniques: either the tunnel could be bored (above left) *or prefabricated tube-segments could be lowered into an excavated trench* (right).

ernment officials, bankers, and the public at large. Of course, not every technological problem, and surely not every social problem, requires such fundamental (and prolonged) intersectoral treatment. But the interdisciplinary, intersectoral, and (where appropriate) international study group does point in the desired direction.

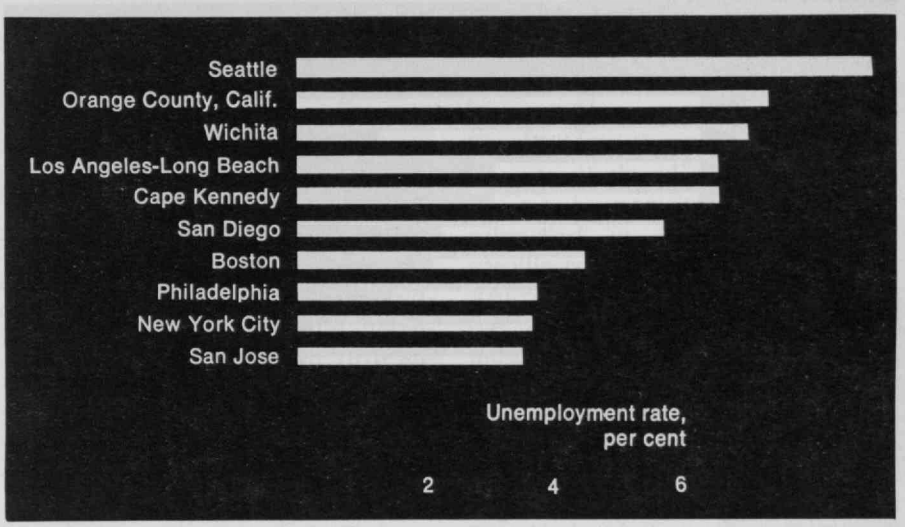
Technological changes have obviously rendered the traditional nation-states of Europe obsolete, as functional divisions, for many purposes; the response has been to create a whole series of new institutions: the Council of Europe, the Common Market, etc. The United States, with its larger territory, has not felt the urgency of institutional re-assessment until recently (although the creation of the United States was, itself, the end-product of a rather searching institutional re-assessment). But the constituent States of the U.S. are clearly inappropriate for many of the modern functions of a regional government. Perhaps the Council of Europe (poorly understood here) can serve as one example for regional groupings (New England, Appalachia, etc.) which could begin with joint conference and research centers and expand as circumstances and opportunities evolve.

by Raymond J. Waldmann
Staff Assistant to the President

Redirection and Re-employment

The results of the nation's shifting priorities for scientists and engineers are widely known. Though shunning massive re-employment programs, the federal government continues efforts to ease the burdens of unemployment.

The effective re-employment and redirection of those affected by cutbacks in aerospace and defense spending is today an important concern of the federal government. The President has frequently called for release of new energies to solve our domestic problems, to improve productivity, and to assure effective competition for American products in international markets. He has directed the Domestic Council to examine the problems to which technology may be applied, the economic incentives which may encourage applications of technology to social problems, and the transfer of technology between countries. One facet of these issues—the plight of unemployed scientists and engineers and what is being done to help them—is the subject of this article.



A National Science Foundation survey completed in August, 1971, showed that 3 per cent of all U.S. engineers were unemployed; but the unemployment rate was far higher than this in the ten geographical areas hardest hit by changing technological priorities. To these figures for "unemployed," the Engineers Joint Council would add engineers seeking full-time work while doing part-time engineering work and those working in nonengineering positions because they could find no engineering jobs; by this definition, another 2 to 3 per cent of engineers are in the "employment problem" category in the areas shown above.

The Scope Of The Problem

While definitions used by the Department of Labor are not always consistent with those used by the Bureau of the Census and by other agencies, we can talk broadly about approximately 50,000 to 65,000 scientists, engineers, and technicians who were unemployed by the end of 1970. A Department of Labor survey of the 40 largest cities identified 50,000 unemployed in June, 1970—roughly half scientists and engineers, the rest technicians. The nationwide total was estimated at 65,000 to 75,000. This amounts to roughly three per cent of the total number of scientists, engineers, and higher technicians known to be in the labor force.

But the distribution of unemployed scientists and engineers was not even throughout the country. Approximately one-third were in the Los Angeles region; other hard-hit areas were San Jose, San Diego, Seattle, New York, Wichita, St. Louis, Philadelphia, Boston, Atlanta, Cape Kennedy, Huntsville, and Dallas.

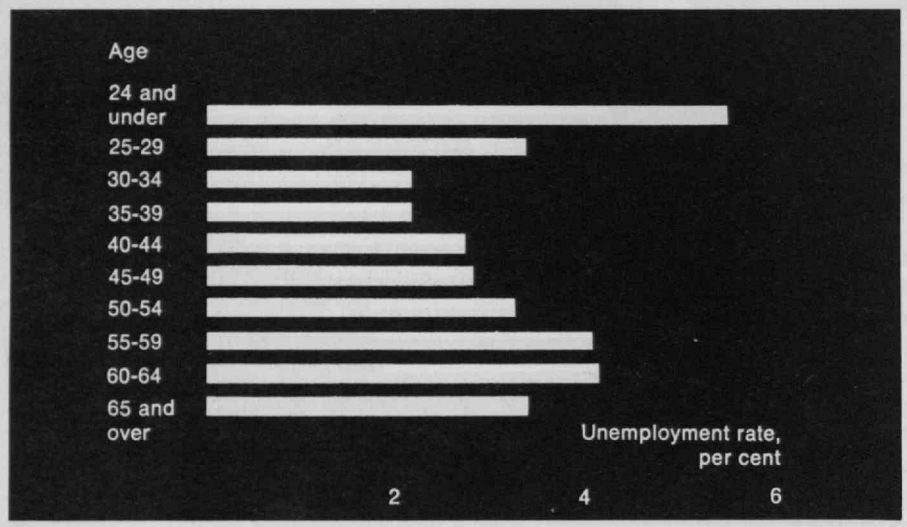
Two simple statements reflect the Administration's point of view and its perception of the problem, and thus may help to explain the government's approach in developing programs of assistance for these unemployed professionals:

☐ Even with an upswing in the economy, there has been and will be a reallocation of national resources which affects the space and defense industries—and their scientists and engineers.

☐ Specific federal programs have been developed to ease the burden which this reallocation brings to scientists and engineers and to smooth their paths to re-employment.

There has been and will continue to be a reallocation of national resources. Since ours is not a centrally planned system but rather a system of counter-balancing forces, the system is always more or less in equilibrium but never static. Priorities change over time. We are affected by economic forces. We respond to different social concerns. We act and react among a peaceful and not so peaceful competition of nations, all with their own interests and aspirations. The summation of these forces is the political process.

Throughout this dynamic process, priorities are continually shaped and reshaped. The President's role in this process is to listen, to lead, and to negotiate a plan of action, but he is only one actor in the drama. There



When National Science Foundation findings made it clear in August, 1971 (above), that young graduates were among the engineers most vulnerable to unemployment, the Office of Science and Technology developed a program for postdoctorate interns to be placed in federally-funded laboratories.

are 535 members of Congress, and nine members of the Supreme Court; and there is a large federal bureaucracy. There are innumerable private individuals, organizations and interest groups attempting to influence the President and his staff, the Congress, and the agencies of the Executive Branch. The focus of much of this attention is what our nation's budget priorities ought to be—that is, crudely, who gets the federal dollar.

In 1970, for the first time in two decades, spending for human resources exceeded defense spending in the federal budget. We are in transition from a wartime to a peacetime economy. In 1971, defense and space spending will constitute 35 per cent of total federal spending, while human resource programs will represent 42 per cent. This fundamental shift reflects the mood and needs of the country.

While the operation of the free market often determines whether businesses succeed or fail and what new products are developed and sold, this kind of marketplace influence is only one factor in defense, where direct federal support and procurement decisions have affected numerous products and companies. Despite their success in the past decade—the defense industries have supplied vast quantities of defense equipment and have developed technology at a very rapid rate—the implication of the present shift in priorities is that, in the future, there will be few major new space and defense programs at the levels common in the 1960's.

There are, of course, bright spots. The National Science Foundation budget has been increased 25 per cent. The President has asked in his budget that the Skylab program go forward, that the Space Shuttle engine design proceed, that the Apollo series continue and that the research and development budget of the Department of Defense be increased for fiscal 1972. But these are not going to return the industry to the big spending days of 1968; the industry and its employees must face the fact that some form of conversion is necessary.

Consider first the prospects for redirecting the defense industry as a whole. The efforts of the industry to find domestic and non-defense applications for technology must be given our best support in spite of a rather pessimistic record. It is alluring to speculate on redirecting our substantial reservoir of highly skilled manpower from defense and space employment to all-out attacks on major domestic problems employing advanced technology, systems development, and all of the skills of the aerospace trade. But a realistic appraisal of the prospects reveals difficulties.

One difficulty is that the market for sophisticated technological improvements for application to domestic problems has not developed in any substantial volume. Even existing technology in these areas is not now being utilized because of economic and political inhibitions. Short of a massive infusion of new federal money to support installation and operation as well as development, few potential purchasers are now in the market. And with extremely tight federal budgets in the

The responsibility of the federal government to combat unemployment and ease its effects pertains—among others—to professionals whose careers have been jeopardized by changes in priorities over which they have no control.

years ahead, that infusion is not likely.

A second problem is the continuing anticipation of major new aerospace and defense programs. Many defense companies are unacquainted in the domestic market, and their engineers are naturally reluctant to change their specialties. The common characteristic of most defense companies and their employees is that they look to federal government for some form of direction. There are important differences between building and selling items purchased solely by the Federal Government and items to be offered to many purchasers. New techniques—and probably higher costs—are involved in marketing to hundreds of purchasers instead of one. The needs for service and support systems and requirements for reliability are very different in the competitive domestic market. Indeed, the business community is still debating the question of whether firms with a history of defense commitments can successfully adapt to take advantage of such domestic markets as may exist for their expertise and products.

But let's assume the worst—that a particular industry or enterprise cannot adapt. What happens to the engineers, scientists, and technicians who joined it in the 1960's when it was an attractive employer and encouraged transfers from other industries? Can these employees immediately turn to new employment when the economy picks up? If assistance is needed, what form will it take?

Federal Programs for Re-employment

The responsibility of the federal government to combat unemployment and ease its effects is widely understood. The disadvantaged, the poor and the members of minority groups who have been discriminated against for so long have long-standing claims for government attention. Young returning Vietnam veterans with special problems deserve assistance. So, too, do professionals whose careers have been jeopardized by changes in priorities over which they have no control. Accordingly, to assist all of the unemployed, the government in 1970 authorized a number of assistance and retraining programs, including those in fields such as pollution control, city and urban management, and transportation technology. The Civil Service Commission and Defense Department established programs to assist individuals being terminated from government or civilian employment.

In November, 1970, as a result of increasing pressure from scientists and engineers, an inter-agency group was formed under the leadership of the Office of Management and Budget with representatives of the Office of Science and Technology, the Departments of Labor and Defense, the Civil Service Commission and the Domestic Council, to examine the problem of professional unemployment, particularly as it resulted from cutbacks in aerospace and defense spending. The group took as its focus finding ways of improving the labor market; it agreed that conceiving many different useful ways of spending $1 billion or more to immediately put unemployed scientists and engineers to work would represent no contribution, since funds of that magnitude were not available. Massive new research and development initiatives, new department spending programs, or other "easy" solutions were not appropriate recommendations. The challenge was not how to spend more money but how to ease the problem without spending money. The group's summary report, recommending a series of efforts to help relocate displaced scientists and engineers in non-defense jobs, was submitted in March, 1971. The specific recommendations were constructed around "city strategies" in the 14 areas where the problem was most acute.

A number of tools were already available. By mid-1971 the Department of Labor had set up 111 job information banks to match local job opportunities with available labor. The National Registry of Engineers (operated in conjunction with the State of California Department of Human Resources Development) was handling job and manpower matching on a nationwide basis. The Administration sponsored an extended job counselling program through the American Institute of Aeronautics and Astronautics, which helped over 8,000 by mid-summer. It also developed an early-warning mass layoff systems program to help industries ease the transition for laid-off employees.

These efforts were just getting underway when the President's Science Adviser, Edward E. David, Jr., and Secretary of Labor James Hodgson met in Washington on March 3 with 40 leaders of professional societies, industry, and universities. Though the meeting was intended to communicate the findings of the government's studies to date and to enlist help in bringing available services to those in need, a number of specific new suggestions achieved prominence because of their emphasis by the group. These included measures to help scientists and engineers find new jobs in areas away from their

homes and to relocate them and a plan to subsidize the mortgage payments and rents of those out of work for a long time. The job relocation measures recommended themselves strongly, but the rent subsidy plan seemed to open the door to new federal responsibility for individual obligations of all kinds.

A key part of any relocation strategy is, of course, having a job to which one might relocate. So this suggestion meant increased emphasis on training activities, expanded efforts to develop jobs, and a renewed study of the transferability of defense and aerospace skills to civilian industry.

Accordingly, early in April Secretary Hodgson announced that $42 million in Manpower Development and Training Assistance was being reprogrammed specifically for efforts to re-employ scientists and engineers. Of the total, $25 million was designated for retraining and on-the-job training, $10 million for relocation, $5 million for job search trips, and $2 million for skill conversion studies. This marked an important breakthrough. It meant the federal government recognized that the problem was sufficiently large to require spending money for the purposes of retraining and relocation.

Following this development, the National Science Foundation quite properly felt that more should be known about the nature of the unemployed—not just their numbers and locations. The foundation therefore conducted two surveys, one of scientists and one of engineers, with extremely interesting results. The surveys showed, for example, that in all of the 14 areas selected by the Department of Labor, the unemployment rates for either scientists or engineers (as a per cent of each profession, respectively) were lower than the unemployment rates for all workers. In most cases, the rate for scientists was less than half of the overall rate; the unemployment rate for engineers was usually higher than that for scientists but still lower than the overall rate. The highest rates were among scientists and engineers under 30 years of age and engineers over 55.

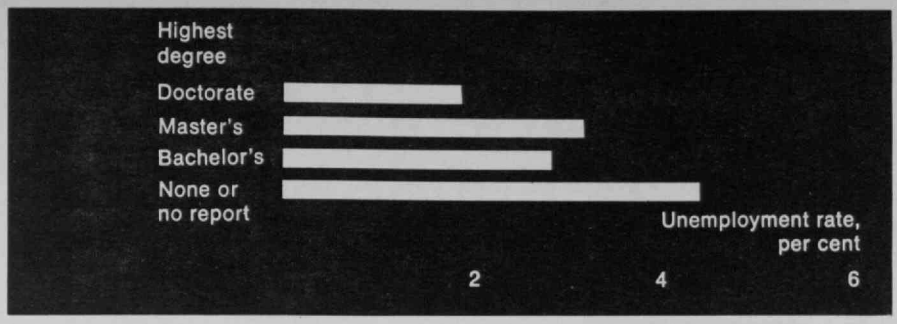
Another interesting conclusion was that the "wind-down" in the space program and defense industries may not have been the scientists' major problem after all. Of 6,300 unemployed scientists who responded to the N.S.F. survey, only 300 were previously associated with space activities and 700 with defense; 1,500 had last been employed in education and another 1,000 in non-defense industry. N.S.F. concluded that "space scientists in the 1970 national register are not now unemployed to the extent that one would have expected." Further, over half of the scientists reporting as unemployed were in the fields of chemistry and physics, where unemployment rates were 3 and 3.9 per cent, respectively —double the rates for those fields in 1970. Among engineers, the results were less unexpected: electronic and aerospace engineers (each with unemployment rates of 5.3 per cent), manufacturing engineers (4.5 per cent), and systems engineers (4.1 per cent) were hardest hit.

The surveys also seemed to show significant differences in unemployment rates according to the highest degree achieved. Among engineers, the unemployment rate for those with less than a bachelor's degree was 4.4 per cent, while that for doctorates was 1.9 per cent; for scientists, bachelor's degree holders had an unemployment rate of 3.5 per cent and doctorates a rate of 1.4 per cent.

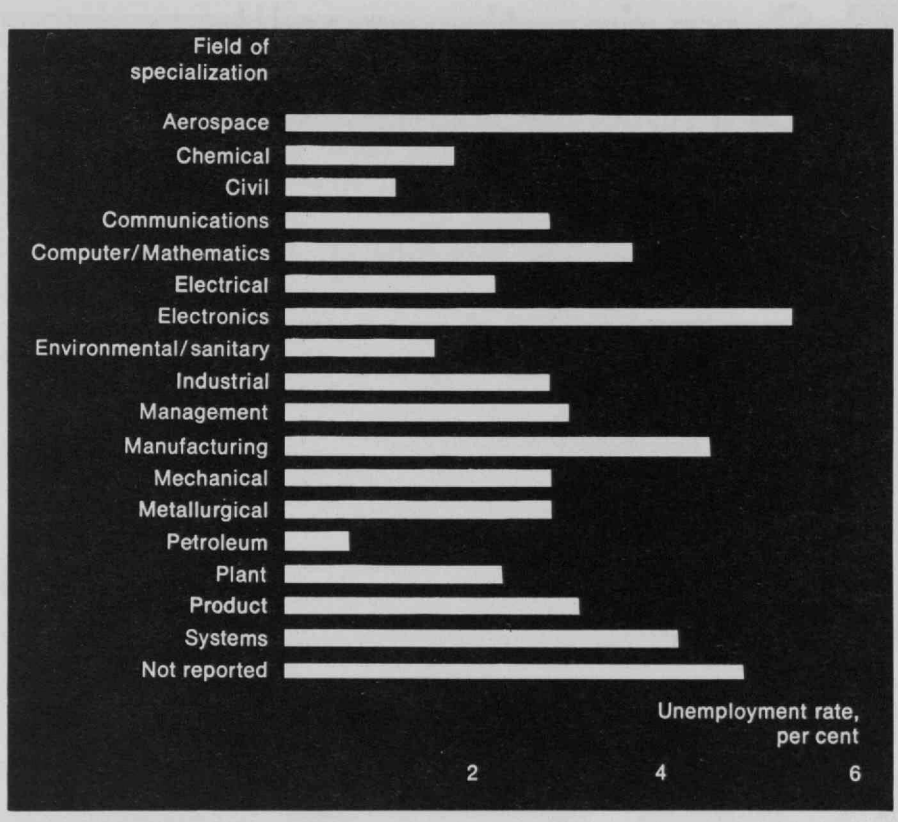
The National Science Foundation findings made it clear that the young graduates who were unable to find jobs and who were most susceptible to easy discouragement and frustration were the most vulnerable. Accordingly, the Office of Science and Technology developed a program to place 400 post-doctorate interns in federally-funded laboratories. This is a one-year, one-shot program with laboratories providing funds matched by $3 million from the Department of Labor. Candidates apply directly to the laboratories for non-renewable internships administered by the National Science Foundation. Veterans and those from high unemployment areas receive preference.

A still more activist federal role with respect to the total of five million unemployed was made possible on July 12, 1971, when the President signed the Emergency Employment Act providing $2 billion over two years to state and local governments for emergency employment. Though under Labor Department guidelines scientists and engineers may benefit from this program, the main thrust of unemployment help for these professionals remains in the Department of Labor's $42 million program.

The results of this Manpower Development and Training Assistance during its first months of operation —as of mid-October, 1971—can be quickly summarized. Some 20,000 applicants had registered under the program in the 14 hardest-hit areas. Approximately 1,400 had been placed in jobs, 571 in jobs paying under $10,000 and the remainder in higher-paying jobs. About 1,000 individuals had used government



No one was surprised when the National Science Foundation reported in August, 1971, on the basis of data gathered by Engineers Joint Council, that engineers without bachelor's degrees were hardest hit by the current unemployment. Even higher unemployment figures were reported for men practicing engineering whose highest degrees were in nonengineering curricula.



National Science Foundation figures showed highest unemployment rates during the summer of 1971 for engineers whose careers were in aerospace or electronics work. Unemployment rates were substantially lower among engineers trained in civil, sanitary, petroleum, environmental, and chemical engineering (and also in agricultural and mining engineering, not shown above).

funds for travel to job interviews, another 230 had used federal funds for relocation, but only 120 had undertaken some form of retraining. In addition, two major projects to study the possibilities of converting skills had been started on a pilot basis in Los Angeles and Seattle. In five months $2.2 million of the $42 million available had been spent.

The total registration of 20,000 is approximately one-third of the target group, now estimated at approximately 65,000 to 75,000 unemployed scientists, engineers, and technicians. Once registered, the unemployed professionals are briefed on government programs, given lists of available opportunities known to the employment services, and given use of employment service facilities to contact potential employers and finance trips. Their resumes are recorded in regional and national computer files which are available to employers. The national registry of engineers in Sacramento now has approximately 13,000 registered.

But of the 20,000 registrants, only about 400 were under 25 and about 4,000 were under 34; it is evident that this program is not reaching the younger unemployed scientists and engineers.

It is also clear from the results to date that job development efforts need to be stimulated. For this purpose, the Department of Labor has now authorized the hiring of state job development officers, all to be former engineers, whose assignments are specifically to help make employers aware of the opportunities that scientists and engineers represent when they are fully utilized.

The President's new economic policy, announced on August 15, provides further incentives for employment of professional people. The job development credit, research and development initiatives, and foreign trade and export development initiatives should all significantly improve the domestic market for scientists and engineers. It is of course not yet clear that these efforts will succeed, or that we will in fact come to view the full utilization of technology as an opportunity instead of a problem.

But the President believes sincerely that a redirection of the American spirit to productive, effective channels is necessary. He does not believe the problem of utilizing scientists and engineers should be "solved" with temporary jobs or highly visible retraining opportunities. The massive changes associated with our shifting priorities must be understood and embraced by the country as a whole.

Most of your friends have never heard of this magazine.

Surprise them with a Christmas gift subscription* which shares your pride in M.I.T.'s new journal.

A few of our 50,000 readers have written us:
". . . too avant garde . . ." ". . . too much engineering (etc.) for me." ". . . still lying on the coffee table with the other magazines." ". . . authoritarian . . ."

But most of them write things like:
". . . an extremely interesting magazine." ". . . one of the top periodicals in the U.S." ". . . unique tidbits on science and technology . . ." ". . . very valuable; one of my prime sources for my course." ". . . often outstanding . . ." ". . . a mind-stretcher!" ". . . constantly amazed at the wealth of information . . ." ". . . one of the most interesting magazines that I have." ". . . keep up the good work."

*Every Christmas gift order will bring nine issues of Technology Review *plus*—early in January—a copy of the Review's book-length special publication, "Energy Technology to the Year 2000," a symposium on the ultimate issue between technology, man, and his environment.

Do your Christmas shopping now. Use the card.

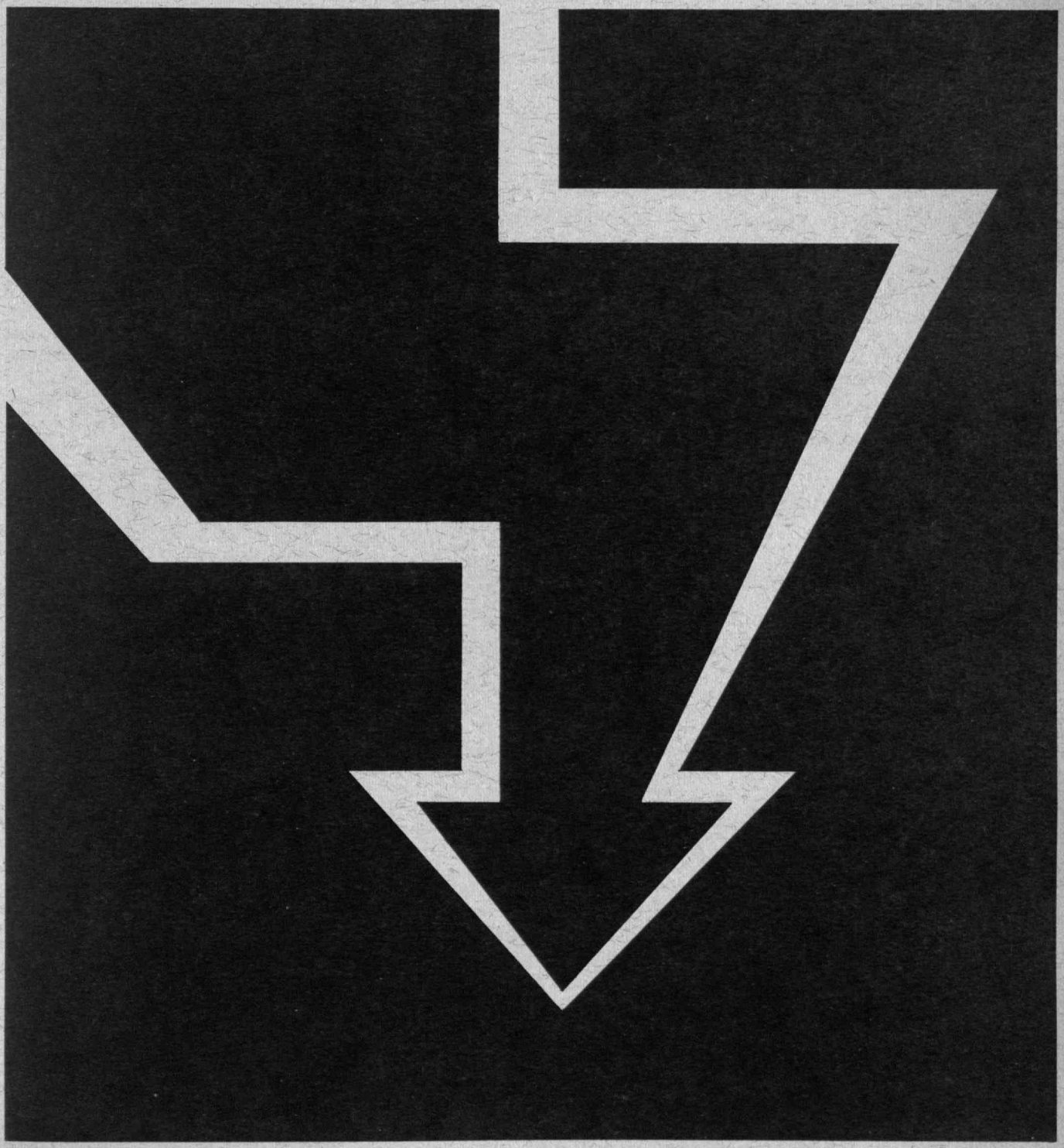
Energy Technology to the Year 2000

Part II: Energy and Pollution

Harry Perry and Harold Berkson on Fossil Fuels

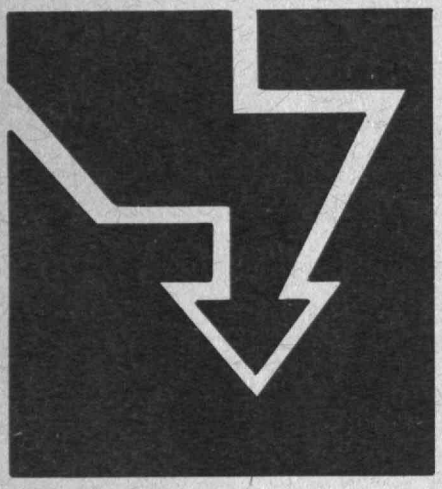
Donald R. F. Harleman on Thermal Pollution

Arthur M. Squires on Combustion



by Harry Perry and
Harold Berkson
Congressional Reference
Service, Library of Congress

Must Fossil Fuels Pollute?



Energy is an indispensible ingredient of economic growth and technological progress. The production of energy is also one of the most pervasive degraders of our environment. Fuels are produced and used in vast tonnages. In 1970, 530 million tons of coal, 710 million tons of oil, and 500 million tons of natural gas were consumed in the United States. The enormity of this aggregate—1.7 billion tons of fuel—can be best understood when it is compared to the 481 million tons of metals and 1.9 billion tons of non-metallic minerals consumed in the U.S. during the same year. Growth rates for fuel consumption are between 3 and 4 per cent per year compared to 1.5 to 2.5 per cent per year for other minerals.

Environmental problems are created at each stage of the production, upgrading, transportation, and utilization of fuels. Some environmental impacts are small and insignificant; for instance, air pollution is not generally important in fuel production. But acid water drainage from coal mines and air and water pollution from electric generating plants have environmental impacts so large as to appear nearly unmanageable or—at best—very costly to control.

Opportunities to channel the environmental insult associated with fuel consumption into more useful outlets depend on a number of factors, of which scale is the primary. When fuel wastes are generated from many small installations or from mobile equipment, the costs associated with their conversion into useful resources are likely to be prohibitive. Thus the air pollutants generated in the transportation sector (representing 24 per cent of total U.S. fuel consumption) and those from residential and commercial sources (representing 20 per cent of the total) do not appear to be attractive as sources for raw materials.

The greatest potential for developing uses for waste fuel products at the present time is for materials generated in relatively large quantities at single locations, whose potential applications are a result of physical or chemical properties. The diversity of our opportunities for turning fuel wastes into resources is significant; clearly, there is no single solution to the problems associated with fuel wastes. The solid waste problems created by mining, for example, may best be resolved by returning the waste material to the mine to prevent subsidence. But in other cases stabilization of a solid waste pile by treating it to encourage the growth of vegetation may be the best solution.

Almost without exception, the solution of preference is one which turns waste into a useful resource. Costs are reduced as the amount of waste to be disposed of is reduced; and if the waste can be converted into a useful product, moreover, there may be positive income. As the cost of waste disposal increases, and as more stringent environmental standards must be met, the incentive and economic potential to convert waste products into usable materials will be greatly increased.

Mine and Preparation Plant Wastes

Solid wastes are produced in large quantities in the course of mining for coal and nuclear fuel. Over 800 waste piles covering about 12,000 acres await attention in the anthracite region of Pennsylvania alone, and estimates show that 90 million tons of waste products were produced at coal preparation plants

The production of energy creates a host of by-products. Our success in dealing with them depends on converting them from wastes to resources—a task on which we have made but a small beginning.

Coal, potential pollution:

	Water	Air	Land	Solid Waste
Production	Acid mine drainage	Mine fires	Strip mining damage	Waste from underground mining
	Leaching of waste piles	Waste pile fires		
	Erosion and silting of streams			
Upgrading	Preparation plant effluent streams	Particulates from fine coal drying		Waste from coal cleaning
	Leaching of waste piles	Nitrogen oxides Waste bank fires		
Transportation				
Utilization	Thermal pollution	Sulfur oxides Nitrogen oxides Particulates } *Power plants*		Disposal of fly ash and slag
		Particulates Hydrogen sulfide Carbon monoxide Hydrocarbons } *Coke ovens*		

Many different environmental pollutants are associated with the many stages of fuel production and utilization in our complex technological society. Some, such as fly ash and slag from the combustion of coal (above), have obvious—if incompletely realized—uses. Others, notably the waste heat from electric power generation, present problems to which only compromises and partial solutions can be envisioned. Tables on the following pages summarize the pollution potentials of other energy sources.

Oil, potential pollution:

	Water	Air	Land	Solid Waste
Production	Disposal of brine			
Upgrading	Thermal pollution	Sulfur oxides		Spent phosphoric acid catalyst
	Sulfuric acid	Hydrocarbons		
	Spent caustic	Nitrogen oxides		Spent clay
Transportation	Tanker accidents		Alaskan pipeline	
Utilization	Thermal pollution	Auto and diesel exhaust emissions		
		Sulfur oxides		
		Nitrogen oxides		

Oil production yields unique fluid pollutants as well as the gaseous by-products of combustion with which we are increasingly familiar. The possibilities of converting these to useful by-products which will substitute for primary resources are limited.

Natural gas, potential pollution:

	Water	Air	Land	Solid Waste
Production				
Upgrading				
Transportation		Nitrogen oxides at compressor stations		
Utilization	Thermal pollution	Nitrogen oxides		

Natural gas, of which—among all energy sources—world supplies are least adequate, presents fewest pollution problems. The authors report that "the most advanced example of commercially practiced conservation of waste material in the fuel industry" is to be found in its treatment.

and another 13 million tons at coal mines in 1965.

These tonnages do not include the waste material created by the strip mining of coal. Approximately 200 million tons of coal were strip-mined in the U.S. in 1970. If the overburden-to-coal ratio averaged only 5 to 1 (and it may have been larger) over 1 billion tons of overburden would have been moved in 1970.

Finding commercial outlets for these materials, for which the cost of mining has already been paid, does not prove easy. Indeed, for at least ten years there have been intensive efforts to develop uses for existing waste piles which have resulted from a century and more of mining and upgrading coal. About a decade ago one large coal company spent several million dollars in an attempt to extract alumina (used in aluminum production) from coal mine wastes. Despite the large potential market (18 million tons of alumina were used in the production of aluminum in 1970) it was not possible to develop a method of using this material which would make the product competitive with that from conventional sources. The use of solid wastes has found application in a few locations, for if the physical and chemical compositions of the waste are suitable, an aggregate can be produced that is useful for cinder blocks and concrete. Some attempts have also been made to use these materials in the manufacture of brick. But in general waste consumption is small compared with the supply, and making these products competitive depends on their distance from large-scale construction projects and the cost of alternative raw materials.

The fine coal in slurries generated

Because stricter pollution standards raise the cost of waste disposal, it is conceivable that waste materials can become competitive with resources the use of which we now take for granted.

at coal preparation plants is difficult to recover. As a result, this material is frequently discharged to streams, with resulting contamination. These slurries have now been used in cement block manufacture at several plants, and they are said to improve the block's resistance to water penetration. Again, the economics of using this waste product depends on the distance it must be transported. Distances of over 40 miles are generally uneconomic, and this limits the potential number of markets.

The waste material generated in coal preparation also contains large amounts of iron sulfide. In many European countries sulfides recovered from such material are used to produce sulfuric acid. During World War II, several plants in the U.S. used recovered iron sulfide, but the process cannot now compete with other methods of sulfuric acid manufacture.

Recovery of saleable coal from waste piles has been practiced sporadically in certain areas in the anthracite region. Where the desired product is large sized material, as little as 20 per cent of the feed may be recovered as clean coal, leaving about 80 per cent still in the solid waste. In waste piles of smaller particles, as much as 40 per cent can be recovered as coal. Material left when waste coal piles have burned, either from natural or man-made causes, is suitable as a cover on secondary roads and as a raw material for ceramics.

The Office of Coal Research has recently supported a research contract in which anthracite waste piles were treated in a fluid bed to determine if the remaining heat values could be recovered and if uses could be found for the solid waste persisting after this secondary combustion. The heat is indeed available, and superior bricks could be made from the waste material; but the economics were unsatisfactory. Some of the burned material appeared to be suitable for use in soil-bitumen construction, but recovery of valuable minerals such as germanium, lithium, and vanadium was not possible.

When other more favorable uses cannot be found, wastes from mine refuse piles and preparation plants can be used to backfill strip pits, can be injected into mines to prevent subsidence, or can be used as clean landfill. Such uses avoid at least part of the potentially adverse environmental effects of such material—there is no air pollution from burning piles, no water pollution from acid leaching, and no unsightly blight on the landscape.

Recent studies by the Bureau of Mines show that the disposal of mine wastes—both coarse and fine—at one mine in Kentucky and another in Alabama costs about 27 cents per ton. Since one-quarter of a ton of waste was produced for each ton of coal at these mines, the disposal costs were only about 7 cents per ton of coal. As more severe pollution standards are established which prevent mining and upgrading operations from simply piling wastes on conveniently nearby land, the pressure for converting these materials into useful resources will increase. Indeed, it is conceivable that disposal costs could increase to the point where use of waste materials in competition with other resources becomes an attractive alternative.

Ion exchange techniques have been used since 1963 to recover uranium from wastes pumped from uranium mines in New Mexico. Initially the recovery of uranium was made from the natural flow of mine water, but as ion exchange techniques have improved it has become profitable to spray abandoned sections of mines to increase the natural flow of water. In all, some 5 million gallons of water are treated daily and 10,000 to 15,000 pounds of uranium—worth between $75,000 and $100,000—are recovered monthly.

Fly Ash Utilization

In contrast to the sporadic and modest market place successes of mine and preparation plant wastes, the market for the fly ash and slag resulting from the combustion of coal has achieved considerable stability both in the U.S. and abroad. By 1969, when an estimated 33.3 million tons of ash was produced in commercial furnaces, over 5.3 million tons was utilized rather than discarded. This 16 per cent utilization compares with European practice, where 30 per cent of the ash is marketed.

The major use for ash and slag is as a concrete aggregate, as additives to cements or in cement kilns, in cellular concrete, in concrete blocks, and in the construction of dams. In most of these applications fly ash is used because it is the lowest cost raw material available to meet specification. For some uses, however, fly ash, recovered from flue gases, increases the quality of the product. For example, when fly ash is used as a partial replacement for cement in concrete mixtures it improves the workability of the mix and the watertightness of the final product, and it yields a product that shrinks and cracks less than standard concretes. In addition, fly-ash concretes produce less heat on setting than standard concretes, a use-

Nuclear fuels, potential pollution:

	Water	Air	Land	Solid Waste	Radiation
Production	Leaching of waste banks Uranium mine water		Strip mining damage	Waste from underground mining	Exposure of miners
Upgrading	Leaching of waste banks	Particulate emission and waste banks		Wastes from ore dressing	Exposure of plant workers
Transportation					
Utilization	Thermal pollution			Waste disposal from fuel processing plants	During generation and disposal of waste

Energy from nuclear fuels commits us to disposing of many pollutants familiar from conventional fossil plants and adds a new dimension—radiation—which remains a highly controversial problem for the future.

ful property in dam construction. As a light-weight aggregate, the advantages of fly ash are that the material does not require mining or crushing and that it usually contains enough carbon to supply the heat required for the sintering operation.

Fly ash-lime in combination with aggregates have been used successfully in a large number of soil stabilization applications, particularly for soils under roads and other pavements. As a mineral filler for asphalt fly ash has the advantage of requiring no sizing or crushing, and it gives a product superior in its resistance to water.

Fly ash has been tested for several different agricultural purposes: as a soil-substitute for growing crops, for restoring surface mine spoil, and for soil modification. Fly ash has been extensively tested, alone and in association with clay, slag, or sand, for the manufacture of brick. Although no commercial bricks are being made from fly ash at this time in the U.S., the potential market is great.

New uses can be anticipated. Tests have shown that some fly ash produces a superior mineral wool, that fly ash may be useful as a filter in the dewatering of sewage sludge, and that, pumped into abandoned mine workings, fly ash may prevent subsidence and acid mine water production. Fly ash is successfully used in Europe in precast aerated concrete blocks for walls, roof, and floor construction; these units are so light that large sections can be erected with minimum handling equipment and reduced labor costs, and the aerated concrete has good strength and is an excellent thermal and noise insulator.

	Fly Ash Tons	Bottom Ash Tons	Boiler Slag (if separated from Bottom Ash) Tons
Total Ash Collected	26,538,019	9,890,951	2,801,475
Ash Utilized:			
Mixed with cement clinker or cement (pozzolan cement)	12,293		
Mixed with raw material before forming cement clinker	146,191	5,850	
Partial replacement of cement in:			
1. Concrete products	168,129	1,900	3,368
2. Structural concrete	238,766		
3. Dams and other mass concrete	129,415		
Stabilizer for road bases, parking areas, etc.	111,309	18,125	70,309
Lightweight aggregate	207,019	50,522	
Fill material for roads, construction sites, etc.	320,304	774,828	497,876
Filler in asphalt mix	131,270		27,077
Miscellaneous	167,302	613,829	479,576
Total	1,631,998	1,465,054	1,078,206
Ash removed from plant sites at no cost to utility but not covered in categories listed under "Ash Utilization"	526,347	377,898	16,156
Total Utilized	2,158,345	1,842,952	1,094,362

The combustion of coal in the U.S. in 1970 yielded over 39 million tons of ash, of which only 14 per cent is effectively utilized. Heavier bottom ash, about one-fourth of the total ash available, finds a larger market than the lighter fly ash which is recovered from stacks to reduce air pollution. (Data: Edison Electric Institute)

Element	Seawater: mg/l	Oil-field Brine: mg/l
Sodium	10,600	12,000 to 150,000
Potassium	380	30 to 4,000
Lithium	0.2	1 to 50
Rubidium	0.12	0.1 to 7
Cesium	0.0005	0.01 to 3
Calcium	400	1,000 to 120,000
Magnesium	1,300	500 to 25,000
Strontium	8	5 to 5,000
Barium	0.03	0 to 1,000
Chlorine	19,000	20,000 to 250,000
Bromine	65	50 to 5,000
Iodine	0.05	1 to 300

Though they vary widely, oil brines associated with the production of crude petroleum compare closely in composition to sea water. If sea water is presently used commercially as the raw material for certain minerals, it is reasonable to assume similar applications for the unwanted brines which accumulate at petroleum wellheads.

With so many present and proposed uses, it is reasonable to predict increasing ash consumption for the near future in the U.S. Large tonnages can be projected, for example, in cement and concrete manufacture; only 700,000 tons of fly ash were used in 1970 in cement and concrete products, while total cement production was over 90 million tons.

Petroleum Wastes From Petroleum Production

Petroleum products yield wastes totally different in character from those from coal—fewer than coal at the well-head (the equivalent of the mine) but many more at the refinery (the equivalent of the preparation plant); and the combustion of oils, both at refineries and at power plants, produces—instead of ash—a deposit on the internal surfaces of flues and stacks from the metallic elements contained in the oils; in at least one refinery the vanadium pentoxide contained in these solid wastes is collected and sold.

Saline water is brought to the surface along with crude oil from many wells, and its disposal—as well as its lifting—represent sources of expense. Most brines are re-injected into subsurface strata, but this method of disposal is now under scrutiny as a potential source of pollution, because one barrel of brine containing 100,000 parts per million of sodium chloride is capable of contaminating 400 barrels of fresh water to the point where the water is not potable. Storage of brines in open pits—another method of disposal which has been commonly used—results in the pollution of surrounding soils and streams.

About 325 billion gallons of saline water are produced annually. As shown in the accompanying table, the concentration and types of dissolved solids vary greatly depending on the geologic formation from which they come. The concentrations of some salts in petroleum brines are high enough to suggest that some brines should be satisfactory raw material for the production of certain minerals. Magnesium, bromine, calcium, and sodium chloride are presently produced commercially from sea water, and petroleum brines have been used commercially to produce iodine, bromine, calcium and other chemicals.

The economics of such processing depends on the cost of pumping brines to the recovery plant, as well as the actual recovery and marketing costs. As costs of brine disposal increase, utilization of brines is also likely to increase—at least in some locations.

In general, the liquid and solid wastes produced at petroleum refineries are difficult to handle, and considerable laboratory work may be required before they become saleable products instead of useless pollutants. (There is also the possibility of changing refining processes or equipment so that a saleable by-product is achieved in place of a difficult pollutant.)

Spent phosphoric acid catalysts and other spent solid catalysts from petroleum refining may be sold under certain circumstances. The spent phosphoric acid catalyst is used by fertilizer manufacturers; the revenue to the refinery is not large, but the costs associated with handling and disposal of these solids is avoided. Other spent catalysts may contain valuable metals such as molybdenum and platinum, and these are sold to catalyst manufacturers for reprocessing.

Disposal of used clays used in refinery operations to decolorize and stabilize gasolines, to decolorize heavy oils, and to "neutralize" acid-treated heavy oils is often a problem, though they sometimes have been sold for cinder block manufacture.

The spent caustic fluid produced in refining operations can sometimes be sold to paper mills, soda-ash manufacturers, and plants making cresylic or naphthanate products. The market for caustic solutions among these consumers depends on the types and concentrations of dissolved solids in the solutions and the cost of transportation from refinery to customer.

Spent alkylation and sulfuric acid sludges produced at refineries can be sold to nearby sulfuric acid plants for reprocessing and recovery of sulfuric acid. In some cases the spent acid has been reacted with ammonium compounds, also produced during refining, to yield ammonium sulfate for fertilizer use. Methods for recovering sulfur compounds removed from crude petroleum during refining have now been added at most refineries, where they substitute for the former practice of burning waste gases with the resulting air pollution from sulfur oxides.

Gaseous Wastes from Petroleum and Natural Gas

Probably the most advanced example of commercially practiced conservation of waste material in the fuel industry is found in the treatment of natural gas before it is shipped by pipeline to markets. Natural gas is usually stripped of the higher molecular weight hydrocarbons (ethane, propane, and butane), which are processed and

If all of the sulfur were recovered from fuel used at U.S. power plants more sulfur would be collected each year than the total present U.S. demand for it.

shipped separately. Hydrogen sulfide is removed when it is present, and about 15 per cent of the sulfur marketed in the U.S. in 1970 came from this source of raw material. When concentrations of carbon dioxide in the natural gas are high and nearby markets exist, it is removed from the gas and marketed. Similarly, when the natural gas contains commercial quantities of helium, it also is removed and sold or stored.

As air pollution standards with respect to hydrocarbon emissions have become more strict, the petroleum industry has installed vapor recovery systems and floating roof tanks on storage vessels to prevent emission to the atmosphere. In some cases these systems have resulted in savings larger than the cost of installation.

Coke Oven Gas

Coke oven plants continue to present difficult pollution problems, though many potential pollutants have been recovered since the turn of the century. Until natural gas displaced it, coke ovens were the principal source of the gas distributed by gas utility companies. Now it is used primarily to fuel the ovens themselves, although some gas is sold to industrial plants in special situations. Ammonium sulfate, light oils, and coal tar products are the other useful by-products. Improved methods to prevent air pollution arising at coke ovens are being developed, but the additional recoverable by-products will be minimal.

Sulfur from the Fuels of the Future

The greatest man-made source of sulfur oxides—75 per cent of all those produced—arises from the combustion of fossil fuels, and—as Arthur M. Squires writes in the accompanying article (pp. 52-60)—the problem of controlling these emissions is very severe. Professor Squires describes the many processes currently under study for removing sulfur oxides from fuel and stack gases. Suffice it to say here that if all of the sulfur were recovered from fuel used at power plants in the U.S. more than 12 million tons would be collected each year—a quantity greater than the total present U.S. demand for sulfur. The surplus of sulfur could be even greater in the future. If natural gas supplies prove inadequate to meet future demands, gas made from coal will become a significant fuel source. And if coal with an average of 3 per cent sulfur is used to provide only one-half of the gas deficiency anticipated in the year 2000, over 15 million tons of sulfur will be recovered as a by-product. In addition if a portion of the liquid fuel required in the year 2000 were also to be made from coal, an additional 10 to 70 million tons of sulfur could be recovered. Since the U.S. demand for sulfur in 2000 is expected to be only 35 million tons, by-product from the manufacture of synthetic fuels could easily supply the total sulfur demand.

Utilization of Waste Heat

Most of America's supply of electricity comes from steam turbine generating facilities. Roughly one-third of the energy released from the fuel in such equipment is converted into useful electricity; the rest is rejected to the environment as a waste product. There are various technologies for this heat rejection process, but whatever they may be, the essential facts remain that energy is being wasted and the environment is being degraded. An array of federal and state regulations have been promulgated to limit the amount and rate of heat discharge from any specific electrical generating plant, and expensive controls are necessary to meet these requirements. Obviously, the best approach to this problem is to consider the waste heat as a valuable resource out of place and to develop beneficial uses for it.

Several physical-chemical factors are extremely important in the development of beneficial uses for waste heat.

First, the heat—other than that emitted through the stack—is available only in conjunction with the waste water; if one intends to utilize the heat and not the water, the thermal energy must be interfaced by some sort of heat-exchanging system. Those applications which propose to utilize both the heat and the water must be compatible with all the other parameters comprising water quality. For example, if the heated effluent has been treated with some sort of toxic agent to inhibit the formation of slimes in the condenser, the subsequent use of that water must be compatible with the presence of that toxic material.

The second major factor limiting the use of heated effluents is that the temperature rise is relatively small. Transmission of this thermal energy must be limited to relatively short distances, and applications requiring high temperatures are eliminated unless changes are made elsewhere in the power-generating process, sacrificing some efficiency in energy conversion to higher heating of effluent.

The problems of thermal pollution and its management are discussed elsewhere by Donald R. F. Harle-

man (pp. 44-51). The sections that follow briefly review some of the possible uses for waste heat. These uses fall into interrelated categories of agricultural, aquaculture, and urban and industrial applications.

Agricultural Applications

The proposed agricultural uses utilize the heat component, the water component stripped of its heat, or a combination of both. Studies have shown that it is technically and economically feasible to heat and/or cool greenhouses, poultry and egg houses, and swine houses with the heated effluents from power plants. The facilities must, of course, be close to the generating plant for reasonable economy. During the summer, film-type evaporative coolers can cool air to within 2° or 3°F. of its ambient wet-bulb temperature, performing as "horizontal cooling towers" capable of transferring excess heat to the atmosphere at the rate of up to five Mw. per acre.

The cost of piping water to such structures appears to be no greater than the cost of ordinary greenhouse heating-cooling systems. But, because waste heat is available at no cost, there is an apparent saving of $2,000 to $8,000 per acre, depending on the crop; an additional investment of some $2 million would provide 1,000 Mw. cooling capacity. These applications would save the utility a capital cost of about $6 million and operating expenses of several hundred thousand dollars per year for construction and operation of cooling towers.

Because studies indicate that feed conversion and efficiency for livestock are greater with controlled temperatures, a proposed project at Brown's Ferry, Alabama, will use power plant effluent discharge for heating and cooling of both a feedlot barn and a poultry house. Additional savings would accrue from the integration of greenhouse and livestock operations. The animal wastes could be recycled to provide nutrients to the plants and the plant wastes could serve as additional feed for the animals.

There are opportunities to utilize just the water portion of the effluent in agriculture. Studies financed by the Water and Electric Board of Eugene, Oregon, and designed by the Vitro Corp. have demonstrated that water sprayed at a temperature of 130°F. from a height of 8 to 10 feet will cool to ambient air temperature by the time it reaches the ground and will not damage field crops even in hot weather.

With proper arrangements, crops grown near power plants could benefit from the heat content of the effluent as well as from the water itself. Studies in the Pacific Northwest have shown that heated discharges may be used to provide crop protection from early and late frosts; the growing season is thus extended by the immediate effect of the heated water as well as by its secondary effect of warming the soil. Toxic materials cannot be added to the cooling water during its use in the power plant if the effluent is to be applied in this way, but alternative methods of slime control exist and should present no technical difficulties or significant cost increases in plant operation. A more serious, unresolved problem is that of seasonal demand: heat is required for only a few weeks in the spring and fall while the thermal output is constant throughout the year. The critical months during the summer, when heat is hardest to dispose of, are also the time of minimum agricultural need. This part-time use therefore must be only one of several methods of using the effluents or of several different applications of the waste heat scheduled so as to permit year-round benefits.

Applications to Aquaculture

Heated effluents may find their most valuable applications in the burgeoning field of aquaculture. Advanced applications are either implemented or well under way in the culturing and mass growing of catfish, shrimp, pompano, flounder and sole, ornamental fish, lobster, oysters, and algae, and there is now considerable enthusiasm and optimism for commercial growing of catfish and trout. These fish can grow year-round if the water temperature can be maintained within the required range. Japan is now cultivating 470,000 tons of fish annually. Yields as high as 200,000 pounds per acre have been reported in the U.S. in flowing steams with temperature control. Trout have found a ready market, and though considerable catfish farming is already underway in Arkansas and Texas, it is not yet clear that catfish can command a market large enough to support a high level of production.

Mariculture (culturing of marine organisms) of shrimp also seems feasible. The University of Miami is currently operating a sizeable shrimp culture pilot operation which utilizes waters similar to the effluent which will come from the nuclear plant at Turkey Point on Biscayne Bay, Fla. (see *Technology Review* for June, 1970, pp. 68-69). Commercial shrimp farms are also being established at Panama City, Florida, and at Key West, Florida. The Jap-

anese have produced harvests of 2,000 pounds or more of shrimp per acre, and this is the target for the Florida industry. The commercial success of these ventures is not yet assured.

Flounder and sole are being grown by the White Fish Authority of the United Kingdom in warm water from the Hunterston nuclear station in Scotland. The Long Island Lighting Co. is engaged at its Northport Plant in a commercial oyster culture operation with the Inmont Corp., and the Maine Power and Light Co. is supporting work which will result in augmenting the growth rate of lobsters by warming their habitat.

In all cases, the most promising possibilities for aquaculture involve the production of high-priced or seasonal foods. One special requirement is significant: once the required temperature regime has been established, no interruption in the flow of warm water is tolerable. This means that once an aquacultural enterprise has begun, the power plant must continue to provide an adequate supply of near-constant-temperature water. Whether this will interfere with normal plant operations or whether this is, in fact, even possible, especially in the case of nuclear plants with their unique safety requirements, must be determined before commercial aquaculture programs dependent upon heated effluents can be started. Failure to provide a constant flow of water tailored to meet the requirements of the crop might involve significant liabilities.

Some of the same problems of reconciling part-time use with full-time supply of waste heat encountered in agricultural applications also exist for aquaculture.

Urban and Industrial Opportunities

The basic problem in using waste heat from power plant discharges in urban and industrial applications is the relatively low temperature of the effluent: it is too hot for the environment to accept without damage, but it is not hot enough to be efficiently applied for beneficial purposes. Current practice is to design power plants to discharge water at less than 95°F., and desirable applications of effluents at this temperature are limited. If, however, the temperature of the effluent is raised to 300°F. by diverting heat from the electrical generating cycle, it can be used in meeting many of the energy demands of urban life at delivery distances of several miles.

The use of hot water for heating is obvious, but its use for air conditioning requires some explanation. There is commercially available an air conditioning system which uses heat at 300°F. to boil water from a lithium bromide solution. As the solution becomes concentrated, it absorbs water vapor from a pool of water which, in turn, is cooled by evaporation. This cooled water is then circulated as the coolant fluid.

S. E. Beall, Jr., of Oak Ridge National Laboratory has projected a design for a new city which would economically utilize all the waste heat from the power plant required for its energy needs. His calculations indicate that such a complex would not only be technologically feasible but also economically advantageous. An actual example of the use of waste heat for district heating exists in Finland where the city of Tapiola Garden (20,000 inhabitants) has been heated in this fashion since 1953. It is easier to postulate creation of "cluster" industrial complexes than creation of new cities to utilize waste heat. An advantage of industrial application is that proximity to some extent reduces the need for augmented temperature. Another possibility is the use of waste heat in water treatment. Warming of waste water accelerates the bacterial and chemical processes involved in its purification, and similarly increasing the temperature of water being purified for drinking purposes increases the efficiency and effectiveness of flocculation and filtration. The increased efficiency could yield savings in chemicals normally required for water treatment.

Marine fouling in power plants has been controlled without the use of chemicals by reversing the flow of cooling sea water through the intake pipes to raise the temperature above the tolerance level of the fouling organism. Heated discharges appropriately distributed could be used to eliminate ice in seaports during the winter where this is a problem. Economic benefits argue strongly for serious consideration of using heated effluents in this manner in the Great Lakes and the St. Lawrence River, though this again raises the problem of part-time need versus full-time supply. Since the viscosity and the density of water decrease with temperature, a change in temperature has an effect on both water flow and sediment transfer. Colder waters have a higher carrying capacity for sediment than do warmer waters, and proper manipulation of water temperature to afford some measure of control over sediment deposition may be a useful application of thermal waste.

General Comments

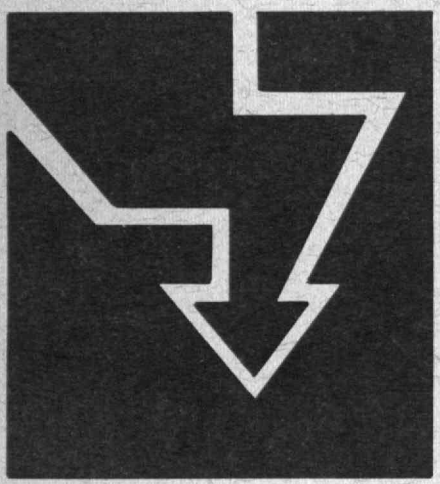
Despite all these possible beneficial uses of waste materials which arise as by-products in the comsumption of fossil fuel, there remains the inexorable fact that the total amount of waste produced is greater than can be used. For example, the waste heat from power generation, if fully utilized, is even now more than sufficient to heat every home in America, and the simple arithmetic of energy utilization for electrical power compared to the energy rejected as waste heat indicates that the situation will not improve.

In 1970, the U.S. had a population of 205 million people, utilizing 1,360 x 10^9 kwh. of electric energy requiring 125 x 10^9 gallons per day of cooling water. The total energy consumption was 5,596 x 10^{13} B.t.u., of which two-thirds—or 3,720 x 10^{13} B.t.u.—was rejected to the environment. Predictions for the year 2000 indicate that our population of 300 million will utilize 6,100 x 10^9 kwh. of electricity requiring 677 x 10^9 gallons of cooling water per day. The total energy usage will be 2,510 x 10^{14} B.t.u., of which 1,674 x 10^{14} B.t.u. will be rejected to the environment.

The message here is clear. Intense efforts must be made to improve our management of energy conversion. We must improve the technology of fuel processing, combustion, and energy conversion, reduce our consumption of electricity, increase cooling facilities (towers, lagoons, etc.), develop more applications for other by-products of energy production which we now fail to utilize and so treat as waste, or accept a degraded environment. In all probability, we shall opt for a combination of these options, placing an even greater burden on environmental managers. Thus we must also concentrate on seeking some method of assessment which will permit optimum selection of the various alternatives in the conversion and utilization of energy in the United States.

by Donald R. F. Harleman
Professor of Civil Engineering
Ralph M. Parsons Laboratory for
Water Resources and
Hydrodynamics

Heat—the Ultimate Waste



Installing central air-conditioning in a home can double the energy the home uses—and our country's electrical generating capacity has doubled each decade for the last five. This growth, at an average rate of seven to eight per cent per year, is far greater than the growth in population as well as in industrial expansion. It reflects public demand for increased power: air conditioners and the like.

Utilities are charged by their charters to meet the power demands of their franchise area, but we can question the wisdom of advertising that increases that demand. (Such advertising has been called "eco-pornography".) We also question whether pollution control can be achieved if protectionist groups devote their major efforts to blocking the construction of generators for which the need already exists.

The generation and distribution of electrical energy, by public or investor-owned companies, are subject to governmental regulation. The number of regulatory agencies at local, state, and federal levels, from which approvals for new power plants must be obtained, has been increasing faster than has the demand for power. Citizens groups form or regroup at the first inkling of a new power plant site, and the battle lines are quickly drawn between the protectors of the environment and the utility.

As one site is blocked, other sites are proposed and the same or new groups repeat the process. Because of the multitude of regulatory agencies the opportunities for blocking through litigation have increased enormously—in one case, litigation has lasted seven years. Many regulatory agencies have the authority to say "no," but none of them has the authority to say "yes". I suggest that the conservationists attack with equal vigor the long-range problem: the growing demand for power.

The pollution problem associated with energy use is highly complex and it involves all forms of consumption. In a densely populated area, ought we to heat homes electrically, to eliminate local pollution from residential burning of fuel oil? This concentrates the pollution at the generating station. Shall the central generating unit use fossil or nuclear fuels? The question for the immediate future is not whether we will have to contend with pollution from power generation, but in what form the pollution is least damaging. In this context, I will restrict the discussion to the waste heat problem.

Why Waste Heat?

The efficiency of power production, by either fossil or nuclear fuels, is governed by the thermodynamics of the heat cycle. The ideal (or Carnot) efficiency is determined by dividing the temperature difference between the heat source and the heat sink (the surrounding air or water) by the temperature of the source. The greater the difference between source and sink, the larger is the fraction and the higher the efficiency. The temperatures are measured on the Rankine scale, which counts from absolute zero in Fahrenheit degrees. (The freezing point of water is thus 492°R., the boiling point, 672°R.) In a modern fossil fuel station the maximum temperatures are around 1660°R. (1200°F.) and the average annual temperature of the heat sink may be 520°R. (60°F.). Thus the ideal efficiency is approximately 68 per cent. A cooler heat sink yields a greater efficiency, but the tempera-

The regulation of thermal pollution is more complex than it first seems to citizens and legislators. The best solution for a particular site may not be had through rigid water temperature criteria, as Dr. Harleman clearly shows.

ture of the heat sink would have to approach absolute zero (−460°F.) for the ideal efficiency to approach 100 per cent. And, as in all mechanical and thermodynamic processes, the working efficiency is itself less than the ideal.

New fossil fuel stations achieve about 60 per cent of this ideal efficiency for an overall efficiency of about 41 per cent. Protective requirements for the fuel rods limit maximum temperatures in nuclear units to about 650°F. (1110°R.), so the ideal efficiency is reduced to 53 per cent and the overall efficiency (at 60 per cent of the ideal) to 32 per cent. In a nuclear plant, then, for every kilowatt of electrical power produced, the equivalent of two kilowatts is rejected to the surrounding air or water as heat. A nuclear plant producing 1000 megawatts will produce 6.6×10^9 B.t.u. per hour as heat to be disposed of; a fossil plant 3.8×10^9 B.t.u. per hour. (These figures allow for differences in plant and stack heat losses.) Nuclear units reject approximately one and two-thirds times as much waste heat as a corresponding fossil unit.

The heat sink consists of a steam condenser through which water is circulated. A typical condenser water flow rate for a 1000-Mw. unit is about 1500 cubic feet per second (675,000 gallons per minute) or 3.4×10^8 pounds per hour. Dividing the heat rejected in B.t.u. per hour by the water flow rate in pounds per hour gives the temperature rise for the water passing through the condenser—11°F. for the fossil unit and 20°F. for the nuclear one. Most authorities see little likelihood of a significant increase in commercial power cycle efficiencies within the next decade or two. Even if a major change in efficiency were to occur it

	Area (km^2)	Population 10^6	EC density (W/m^2)	EC per Capita, kw.	Average net radiation (W/m^2)
Nordrhein-Westfalen	34,039	16.84	4.2	8.0	50
Same, industrial area only	10,296	11.27	10.2	8.9[b]	51
West Berlin	234[a]	2.3	21.3	2.0	57
Moscow	878	6.42	127	16.8[b]	42
Sheffield (1952)	48[a]	0.5	19	1.6	46
Hamburg	747	1.83	12.6[a]	5.0	55
Cincinnati	200[a]	0.54	26	9.3	99
Los Angeles County	10,000	7.0	7.5	10.3	108
Los Angeles	3,500[a]	7.0	21	10.3	108
New York, Manhattan	59	1.7	630	21.0	93
21 metropolitan areas (Washington-Boston)	87,000	33	4.4	11.2[c]	~90
Fairbanks, Alaska[a]	37	0.03	18.5	21.8	18

[a] Building area only [b] Related to industrial production [c] Eastern United States

Rises in energy use are predicted by various sources to be anywhere from 3.8 to 7 per cent per year. Yet the energy consumption of some urban areas is today of the same order of magnitude as the average net natural radiation of the area, as this table indicates, and for New York and Moscow it is larger. (The table covers data from 1965-1968.) The data was collected by H. Flohn and presented to the Study of Man's Impact on Climate this summer in Stockholm. (See Robert C. Cowen's Science Report *in* Technology Review *for October/November, p. 7.)*

would quickly be cancelled out—as regards the quantities of waste heat produced—by the growth curve for electrical energy.

What To Do With It?

Are there beneficial uses for these vast amounts of waste heat? The usual suggestions include heating homes or even greenhouses, desalinating sea water, melting the ice in areas which are closed to navigation in the winter, increasing production of fish by raising water temperatures in the winter, extending growing seasons by using heated water in irrigation, and producing upwellings in the ocean in order to increase surface water nutrients. Some of these are currently operating on a small scale; however, even the most optimistic estimates amount to only a small fraction of the present and future amounts of heat rejected.

The large generating stations now being planned are designed to operate continuously at nearly full load. Most of the beneficial-use plans suggested use heat only intermittently or seasonally; they do not continuously diminish the magnitude of the local heat disposal problem. This is especially a problem since peak power demands occur in the summer in many regions.

It is pertinent to distinguish between beneficial uses and beneficial effects. A true beneficial use for waste heat should replace other forms of energy including electrical energy. Residences in Iceland's capital city, for example, are heated by dual pipe systems which distribute heated water from natural geothermal sources. Hot water at 180°F. enters the houses and is returned, after passing through a radiation system, at 110°F. While it would be technically possible to design a thermal power plant to produce condenser water discharges in this temperature range, the higher heat sink temperature would significantly lower the electrical efficiency. At the more efficient range of 80 to 100°F., a radiation system large enough to utilize such low quality heat would be impractical. Seasonal utilization is again a problem, as is the economic disparity between energy transmission by heated water in pipes and by electricity in wires.

Beneficial effects of heated discharges, as in the field of aquaculture, should be encouraged; however, we must recognize that the fish thus produced will not absorb or dissipate any of the heat.

The ultimate heat sink is outer space. The recent report of the Study of Critical Environmental Problems (*Man's Impact on the Global Environment,* M.I.T. Press, 1970) considered the climatic effects of all forms of heat release on a global and regional basis. The estimated thermal waste of the world in 1970 was 5.5×10^6 Mw.; this was not considered to have any significant global climatic effects. In the northeastern section of the United States, where 40 per cent of the national energy use occurs, the thermal waste is currently equal to approximately 1 per cent of the absorbed solar energy and it is projected to reach 5 per cent by the year 2000. Within the 4000 square miles of the Los Angeles basin the waste heat is already estimated to be about that. No climatic effects are involved.

How To Dissipate Heat

The following brief descriptions of various heat dissipation techniques are presented without appreciable emphasis on the economics of the various methods. Particular features of a given site can affect the costs of various alternatives; in addition, quotations of costs sometimes reflect the bias of the group presenting them. The public seems willing to incur reasonable additional costs for environmental protection. However, there is a danger of overreacting to the problems of thermal discharges by the imposition of rigid national controls. These could force utilities to invest large amounts of money in one aspect of environmental protection that could be more effectively spent in other areas.

Heat is transferred within the power plant to cooling water as it passes through the condenser. If a continual supply of new water is available to the condenser intake, the process is called *once-through* cooling. If the cooling water is recirculated and the heat is removed from it through some auxiliary mechanism, the process is called *closed-cycle* cooling. The need for a large natural supply of cooling water for once-through cooling has until recently been a prime factor in power plant site selection. The advent of nuclear power, the economy of scale for both nuclear and fossil units, and the growing concern with the environmental effects of large water temperature changes now combine to limit the locations which can use this form of heat dissipation. Good engineering design together with an assessment of biological effects, however, will enable once-through cooling to remain a viable cooling process in major rivers, reservoirs, large lakes, and coastal waters. Heat will dissipate from the water surface and the water return to its natural temperature within a reasonable distance from the place

For every kilowatt of electrical power produced, the equivalent of two kilowatts of energy is rejected as heat to the surrounding air or water. But the method of discharge can affect the temperature distribution—and therefore the biological impact—of this surplus heat.

the heat is added. This distance depends on the amount of dilution of the heated condenser water by the receiving water.

Once-Through Cooling

Heat is dissipated from a water surface by evaporation, radiation, and conduction, and the percentage of the total heat dissipation by evaporation increases as the temperature of the water surface increases above its natural state. If less heat is lost by evaporation than by other methods, less water is consumed—since water is also lost. For a water surface at 5°F. above equilibrium, the heat loss by evaporation is about one-third of the total. This consumes something less than 1 per cent of the cooling water flow rate in a once-through cooling unit.

Changes in the way heated water is discharged—and thereby in the temperature distribution in the receiving water—can minimize the biological impact. Design possibilities range from complete stratification to complete mixing of the heated effluent. In stratification, the heated water is "floated" onto the receiving water in a relatively thin surface layer. Heat dissipates to the atmosphere at a maximum rate and there are no temperature changes at or near the bottom of the receiving water. Because the heated layer will spread easily, it must be stopped from re-entering the condenser water intake. A skimmer wall, with an intake opening at the bottom, will accomplish this.

The sort of thermal discharge regulations that prescribe maximum surface temperature differentials in the receiving water usually prohibit highly stratified surface discharges. However, to achieve a lowered surface temperature the velocity at the exit of the surface discharge channel can be increased by drawing (entraining) the surrounding water into the heated discharge.

Complete mixing of the heated discharge with the available flow past the site is the other extreme of possibilities. The condenser water is conducted through a diffuser pipe and discharged through nozzles or ports near the bottom of the waterway. Entrainment of surrounding water into the high velocity jets produces a rapid dilution. This discharge provides the most rapid temperature reduction within the smallest area, but more heat is stored in the water as the heat dissipates more slowly from the surface.

Reservoirs that were originally constructed for hydroelectric developments are major sources of cooling water. Under certain conditions, the location of a thermal power plant on such a reservoir may in fact improve the water quality. Because of solar heating at the water surface, reservoirs tend to stratify during the summer, and temperature differences of 35°F. from surface to bottom are common. If the reservoir contains organic material loads, the cold hypolimnion (bottom) layers can become devoid of dissolved oxygen. The hydroelectric turbines usually take in water from near the bottom of the reservoir; thus water quality in the river downstream can be severely impaired.

How to mix the layers in a lake or reservoir is presently under study. Pumping devices, for example, bring the hypolimnion water to the surface where atmospheric oxygen can re-aerate it. A thermal power plant that withdraws water from the lower levels and discharges at or near the surface will have the same effect. This technique should not be used on small lakes or in reservoirs with a large number of cold-water fish or in which the heat could affect the thermal stability, delay the fall "overturn," and perhaps accelerate the eutrophication process.

Once-through cooling is important in coastal waters where auxiliary cooling alternatives are most limited. Except in shallow embayments, tidal and wind driven currents are generally available for rapid dispersion and dissipation of the extra heat.

The primary advantages of once-through cooling are the low consumptive use of water, the ability to tailor the temperature distribution field in the receiving water to meet biological objectives, and the dispersal of heat dissipation to the atmosphere over a large area.

The disadvantages of once-through cooling are related to the possible damage to aquatic life from a higher water temperature. Biochemical processes, including the rate of the use of oxygen, increase with rising water temperature; the ability of water to hold dissolved oxygen in solution, however, decreases. Laboratory and field experiments have established the temperatures beyond which there is death or an impairment of biological functions for fish and other parts of the food chain. Indirect effects, which are more difficult to measure and evaluate, include the possibility of increased susceptibility to disease and increases in predators or less desirable species. Precautions must also be taken to prevent damage to fish by trash racks and screens at the condenser water intake. Extensive efforts such as the development of moving fish screens and limitations on intake velocities have greatly reduced fish kills. Smaller organisms such as zooplankton pass through

the intake-condenser-discharge system. The effects of their passage depend upon both the temperature rise and the time of exposure.

Water temperature increases which approach the sub-lethal range of impaired biological activity should be avoided. Most states therefore limit both maximum temperatures and allowable temperature rises, from 1½° to 5°F., for various types of receiving waters. There is no general agreement among aquatic biologists as to whether temperature increases in these magnitudes from waste heat are harmful. Natural daily temperature changes in most bodies of water are in the same range.

Closed-Cycle Cooling

Closed-cycle methods of heat dissipation include cooling ponds, spray ponds, mechanical and natural draft evaporative cooling towers, and mechanical and natural draft dry cooling towers. In each case, water is recirculated between the condenser and the heat dissipator.

Cooling ponds are used widely in the southwest where extensive land areas and low humidity provide effective surface cooling. Under these conditions, a 1000-Mw. station requires about 1000 acres of water surface. High humidity can more than double that requirement. This factor, and the high cost of land in densely populated areas, has limited the use of cooling ponds in the East. Spray systems can be added to increase the heat dissipation. However, the water loss from evaporation and drift can be significant in some areas.

Cooling ponds and spray ponds may also be used in conjunction with once-through cooling schemes. In this manner, a portion of the heat may be dissipated in the pond before the cooling water is discharged to an adjacent waterway.

Most cooling towers constructed for power plants above 500 Mw. have been of the natural draft wet, or evaporative, type—large hyperbolic towers that cool by creating a natural draft of air which passes through water droplets sprayed by nozzles within the tower. Cooled water collects in a pool at the base of the tower. The lowest water temperature in these towers will always be above the wet-bulb temperature of the surrounding air. A natural-draft tower for a 1000-Mw. nuclear unit would be 600 feet at the base and 500 feet high.

A source of make-up water must be available to replace that lost by evaporation and drift and to provide blow-down water to prevent build-up of chemical residue by evaporation.

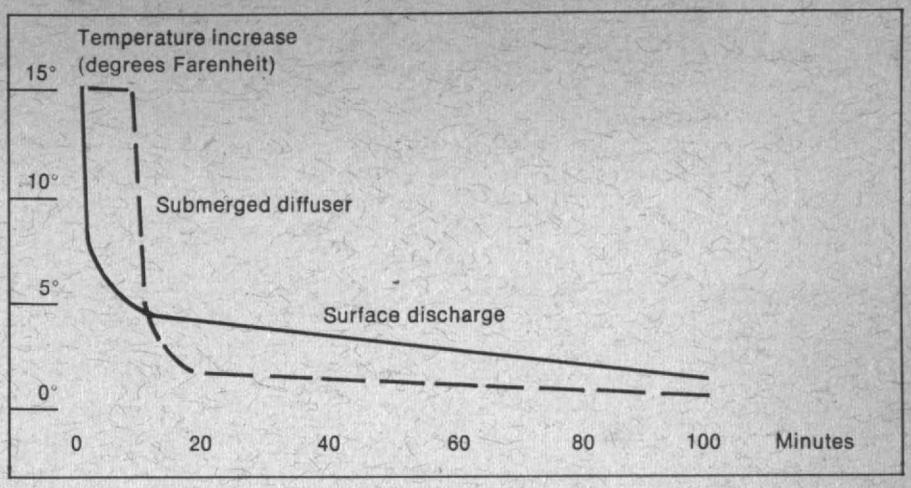
Since the cooling is primarily by evaporation, the tower consumes about two and one-half times as much water as the once-through cooling processes; about 3 per cent of the total amount circulated must be replaced. A typical 1000-Mw. nuclear unit needs some 30 million gallons per day. These amounts are presently not a serious problem to the nation, but the consumption projected for 20 to 30 years presents a significant limitation on this method of cooling. A cluster of huge towers may, in addition, be unsightly.

Although cooling towers are usually cited as the solution to the thermal pollution of natural water bodies, they pose environmental problems in certain areas. Fresh water supplies, especially in coastal regions, may not be large enough to replace water lost. It would seem logical to use sea-water as the coolant in these instances, but the transport of water droplets out of the cooling tower, known as drift loss, is estimated to be in the range of one-tenth of one per cent of the amount of water circulating. For a 1000-Mw. nuclear unit, the drift loss could be as much as 1 million gallons per day. As sea-water contains about 30,000 parts per million of dissolved salts, the production of solid salt after evaporation would amount to 125 tons per day in the plume downwind of the tower. Even if the drift loss were reduced by a full order of magnitude, the deposition of more than 10 tons of salt per day downwind might be unacceptable.

Mechanical-draft wet cooling towers are generally 50 to 75 feet in height. Air is forced through the spray by large motor-driven fans. Capital costs are appreciably lower than for the natural-draft towers, but much higher operating costs must be considered in comparing the two types. There are other problems: the low moisture-laden plume can cause fog and ice especially in cold, humid climates, and the recirculation of heated air between tower exit and intake may be troublesome.

Dry cooling towers, whether natural or forced draft, avoid the difficulties of evaporation and drift loss as well as of fog and ice production. They transfer waste heat to the air passing through a fin-tube heat exchanger through which the cooling water is circulated in an enclosed system. The minimum cooling water temperature will always be higher than the ambient dry bulb air temperature—a severe penalty on the thermal efficiency in warm areas. Dry towers must be appreciably larger than wet towers and cost estimates are generally from three to five times larger. A natural-draft dry

Heat from a power plant may be discharged to a large body of water through a channel emptying at the surface or through a discharge pipe submerged on the bottom. The diagrams on the next page demonstrate the differences in heat diffusion between the two discharge methods, while this chart contrasts the effects of each method on marine organisms cycled through the cooling plant. Because water in the submerged diffuser must travel a long distance to reach its discharge point, whatever living creatures are in it will be exposed to high temperatures for much longer times than in the surface device.



tower, 350 feet high and 325 feet in diameter, has been built on a small generating station (120 Mw.) in England, but no dry towers have been built at a major electric power plant in the United States.

The meteorological effects of dispersing large amounts of heat from cooling towers at large central stations have received relatively little attention. One estimate is that the kinetic energy produced by thermal updrafts may approach that of natural thunderstorms or tornadoes.

The Impact of Water Temperature Standards

There is no universal answer to the problems of use or dissipation of waste heat. I consider as desirable a situation in which aquatic biologists specify optimum temperature conditions within the guidelines of regional temperature standards. Engineers can then design condensers and intake and discharge structures to achieve the best temperature distribution. The trend toward inflexible temperature regulations unfortunately precludes this type of optimization.

Most thermal pollution controls are geared to once-through cooling systems—the most widely used—and rigidly define temperature limits for various classes of its receiving waters. The criteria governing thermal discharges in coastal waters currently employed in a number of states are an example of rigid regulation: the water temperature at the surface of coastal waters shall not be raised more than 4°F. over the monthly means of maximum daily temperatures from October through June nor more than 1.5°F. from July through September except that this temperature may be exceeded within a radius of 300 feet or an equivalent area from the point of discharge.

There are immediate difficulties. First, in the absence of any man-made thermal discharges, a literal interpretation of this regulation would place coastal waters in violation of this standard during about one third of the days of a typical summer month. It is not unusual for the natural daily maximum temperature to exceed the monthly mean of the daily maxima by several degrees. Secondly, the criteria refer only to water surface temperature outside of an area of approximately six acres. A hypothetical case will illustrate their impact.

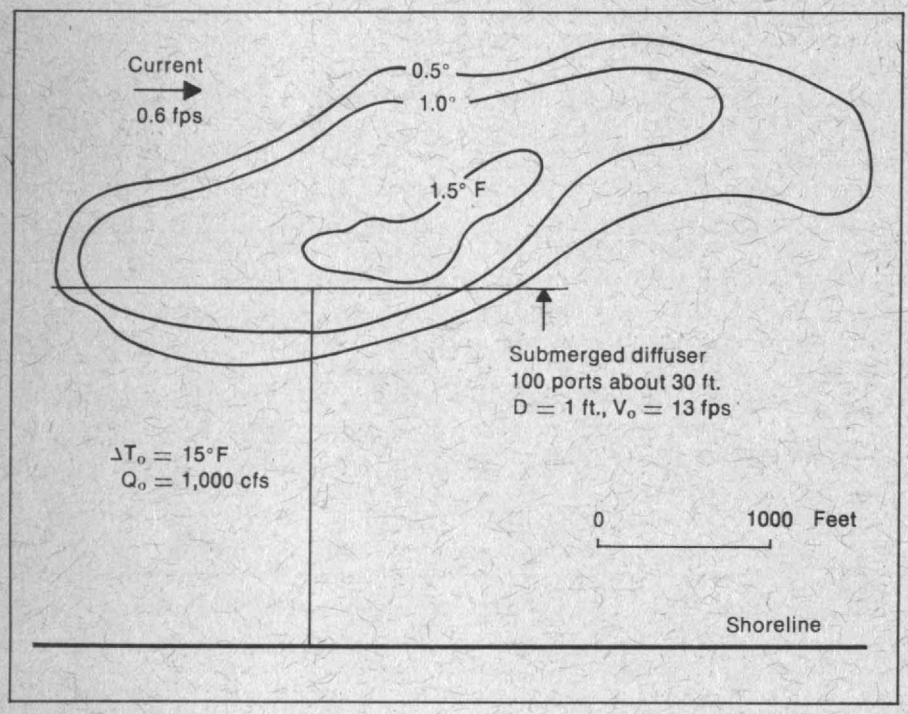
A 525-Mw. nuclear power station is to be located on a coastal site in the northeast. Preliminary investigations of alternative heat disposal schemes have ruled out evaporative cooling towers using fresh water because of the lack of adequate fresh water supplies for make-up water. Local air pollution control standards have also eliminated the use of sea water in the cooling towers because of limitations on particulate salt emissions in the plume. It is decided to employ once-through cooling using the adjacent open coastal water; hence, the above temperature criteria must be satisfied.

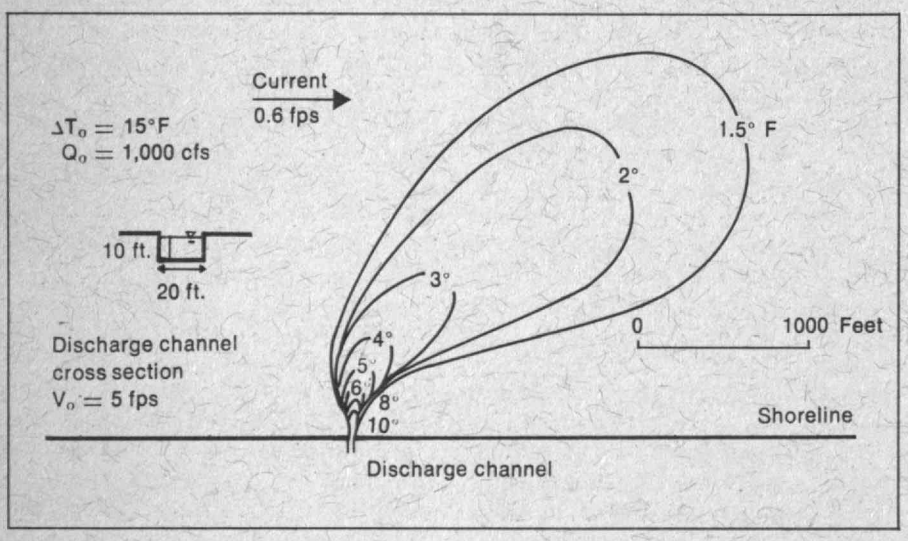
Recent research in the Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics, in M.I.T.'s Department of Civil Engineering, has been directed toward alternative ways to disperse and dissipate heat in shallow coastal waters. The results of two quite different designs for the same hypothetical power station are shown on page 50. The upper diagram shows the water surface isotherms (temperature rise above ambient) for a submerged diffuser located 2000 feet from the shore and extending for 3000 feet parallel to the shoreline. This diffuser consists of 100 ports, each one foot in diameter, discharging condenser water horizontally near the bottom at a velocity of 13 feet per second in the offshore direction. A prevailing ocean current of 0.6 feet per second moves parallel to the shoreline. The water surface area within the 1.5°F. isotherm is approximately six acres; therefore, the diffuser satisfies the summertime temperature criteria for coastal waters.

An alternative method is to discharge the condenser water from a single surface discharge channel 10 feet deep and 20 feet wide located near the shoreline. The discharge velocity is 5 feet per second and the resulting surface temperature isotherms are shown in the second diagram (plotted to the same scale as the first). It is apparent that the surface discharge does not satisfy the temperature criteria because of the larger surface area enclosed by the 1.5°F. isotherm. In both schemes the temperature rise through the condenser is 15°F. and the cooling water flow rate is 1000 cubic feet per second.

The Means Give Different Ends

The important comparison is shown in the diagram on page 51, where the vertical isotherms along the centerlines of the heated discharges are compared for the two schemes in a water depth of 30 feet. The surface discharge channel produces no change in temperature or velocity along the ocean bottom, whereas the submerged diffuser, which satisfies the temperature criteria, results in significant temperature increases and high velocities near the bottom. Much more heat is stored in the





The method of discharging waste heat that conforms to legal temperature criteria may not be the best for the receiving waters, as this pair of diagrams shows. The effects of two different diffusion mechanisms for a 525-Mw. nuclear power plant proposed to be built on the Northeast coastline—a surface discharge channel and a submerged diffusion pipe —are compared. The lines (isotherms) in all four diagrams connect points of equal water temperature increase due to the discharged warm water.

When the warm water outflow is through a submerged diffuser, the heat leaves the pipe near the bottom of the receiving water, and the higher temperatures are concentrated there. Therefore surface temperatures (top diagram, this page) remain low, and only a small amount of heat is dissipated to the air. The area of water surface within the 1.5° isotherm meets the legal criteria established by the state for which the facility is planned. If the waste heat enters the ocean through a discharge channel at the surface (lower diagram, this page), the warm water tends to float so more heat is dissipated to the air. But the areas enclosed by the isotherms are larger and surface temperatures exceed the criteria.

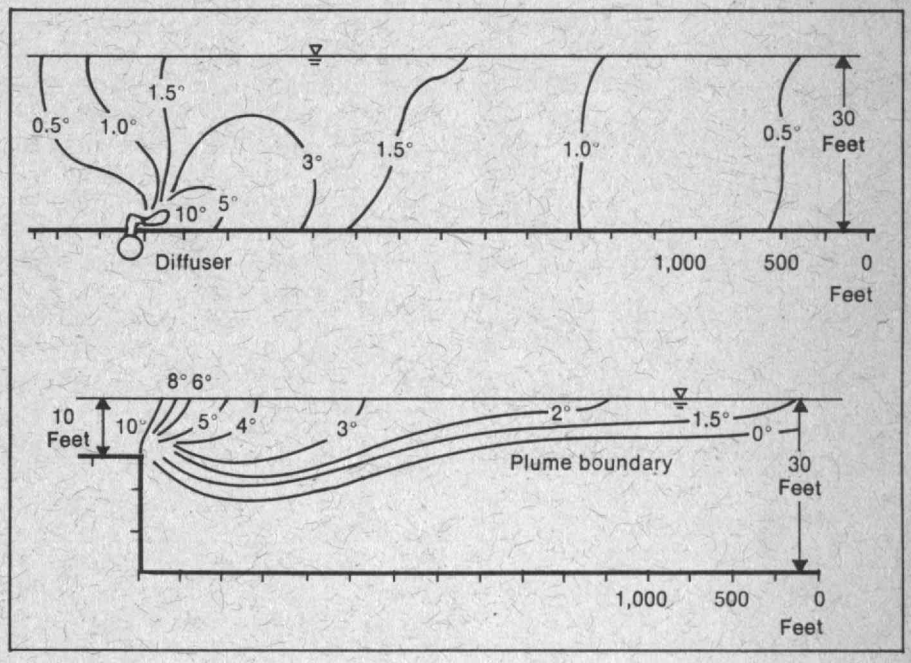
What the two heat discharge methods do underwater is shown by the diagrams on the opposite page. Heat from the submerged discharge (opposite, top) is distributed widely, greatly affecting temperature and velocity at all depths. But the heat from the surface discharge (opposite, lower), dissipated almost entirely from the surface, has essentially no effect on the water at depths greater than 10 ft.

If environmental quality controls are to yield maximum benefits, it is important to question the wisdom of simplistic and inflexible criteria.

water for the submerged diffuser scheme because the smaller surface temperature rise results in a lower rate of surface heat dissipation.

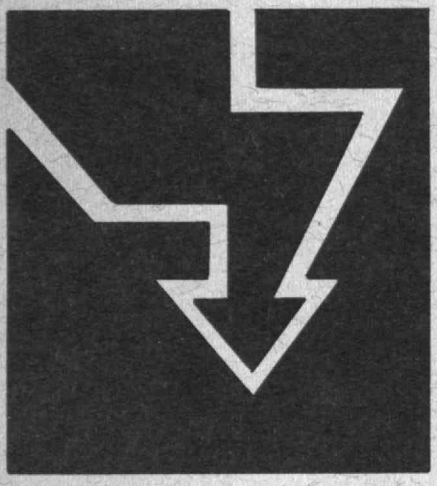
A further comparison can be made in regard to the time of exposure to elevated temperatures of marine organisms passing through the cooling system. As shown in the diagram on this page, the exposure to high temperatures is significantly longer for the submerged diffuser due to the travel time in the long pipe lines involved in this structure. Because of the reduction of exposure time, and the absence of high discharge velocities and bottom temperature change, the ecological impact of the surface discharge scheme appears to be significantly less than that of the submerged diffuser. As a final point, the submerged diffuser is estimated to cost at least $5 million more than the surface discharge channel. Since power utility costs are reflected in the rate structure, the consumer ultimately pays.

I feel it important to question the wisdom of simplistic and inflexible criteria for environmental protection. In this period of pressing needs for environmental quality control, both public and private investments must be made in areas where maximum environmental benefits are to be obtained. Yet regulatory agencies are under heavy political pressure to provide and enforce criteria of the type discussed above. Concerned citizens and conservation groups feel comfortable when such "standards" are imposed. Utilities, operating under the frustrations of power shortages and delays in new construction are reluctant to "rock the boat." Their approach is usually, "What must we do to get a license?" The result is a chaotic approach to energy production.



by Arthur M. Squires
Professor of Chemical Engineering
The City College of the City University of New York

Capturing Sulfur During Combustion



So many enthusiastic announcements have appeared concerning so many and varied schemes for removing sulfur dioxide from the stacks of power stations that even people who attempt to follow the technology closely have sometimes concluded that one of our most stubborn combustion problems has been solved, that not one but even a number of schemes are now ready for commercial use. Nothing is further from the truth. Nothing has fundamentally changed since a distinguished panel of engineers, organized under the auspices of the National Academy of Engineering, concluded in February, 1970, that "commercially proven technology for control of sulfur oxides from combustion processes does not exist." The panel judged that a process must pass the test of operation on the scale of 100 Mw. or above before it could be judged commercially proven. By this test the panel's conclusion of February, 1970, still stands in November, 1971.

Desulfurizing Combustion Products

Many engineers who have studied the problem of removing sulfur dioxide from boiler stack gases are reaching the same conclusion: solutions for this problem are difficult and at best inherently expensive.

What at first seemed an easy solution, injecting lime or limestone along with fuel into the combustion chamber, simply does not work in any version tried to date. The plan is that the calcium of the limestone will absorb the sulfur as calcium sulfate ($CaSO_4$); but unfortunately $CaSO_4$ has a larger molecular volume than calcium carbonate ($CaCO_3$) or quicklime (CaO). The first $CaSO_4$ reaction product forms a shallow, impervious layer that seals off the interior of a particle of lime or limestone and prevents its further reaction to capture SO_2.

Another seemingly easy solution, scrubbing stack gases with a suspension of lime or limestone, has proved surprisingly difficult if the requirement is also imposed that no liquid discharges other than clean water be allowed. Estimates of the installation cost for systems of this type for coal-fired boilers have escalated from below $10/kw. to $40/kw. as the engineering difficulties have become clear. A major additional problem is disposal of the calcium sulfate, and accordingly estimates of operating cost have risen from the range of 2 to 4 cents per million B.t.u. of fuel burned to somewhere between 15 and 30 cents per million B.t.u.

Numerous systems have been proposed which lead to a sulfur by-product. Systems which yield sulfuric acid present the operator with a serious marketing problem, and in many locations he is likely to bear shipping charges to distant consumers simply as a cost for disposing of the acid. Other systems yield sulfur dioxide (SO_2) gas, and there is lacking a good process to convert SO_2 to elemental sulfur, a commodity easier to market or stockpile than sulfuric acid. Only a few systems are envisioned to yield elemental sulfur directly.

Prototypes of the sulfur control systems just described are under construction at plants in the vicinity of 100 Mw., and costs will range as high as $70 per kilowatt. This compares unfavorably with the capital cost for desulfurizing residual oil remaining from Venezuelan crude by catalytic hydrogenation after lighter products—gasoline and jet and Diesel fuels—have been recovered;

Though controlling sulfur from fossil fuels is not yet practical, new chemical technology now holds promise of a dramatic increase in the efficiency of power generation and the eventual elimination of sulfur pollution from large-scale fossil-fueled plants.

this desulfurization is estimated at about $13 per kilowatt if it be assumed that the power station using the desulfurized oil operates at 70 per cent load factor. No wonder power engineers are beginning to lose interest in techniques for removing sulfur at the end of the processing sequence, where it must be dealt with as SO_2 to be removed from stack gas. Instead, they are increasing attention on the possibilities and advantages of dealing with sulfur at an earlier stage in the combustion process.

Desulfurization of Coal and Oil

Processes are already in an advanced stage of development for desulfurizing residual oil by catalytic hydrogenation. Studies are underway on processes by which low-sulfur fuels can be made by reacting coal with hydrogen at extreme pressures and at temperatures in the neighborhood of 450°C. In one version, the "H-Coal" Process of Hydrocarbon Research, Inc., the coal would be treated catalytically in a process closely resembling that for hydrodesulfurization of residual oil. The process, which includes removal of the coal's ash matter by filtration, would yield an oil much resembling residual oil. In another version, under development by Pittsburg and Midway Coal Mining Co. (a subsidiary of Gulf Oil Co.), coal would first be dissolved in an aromatic solvent, then treated with hydrogen, then filtered from its ash matter, and finally removed from the solvent to furnish a product in the form of a solid pitch, termed "solvent-refined coal." Published cost estimates suggest a capital cost for processes of this general type of between $35 and $50 per kilowatt for supply of fuel to a large power station operating at 70 per cent load factor.

Power-generating sites of more than 1,000-Mw. capacity are common. The throughput of oil for an oil-fired station at this capacity is comparable to throughputs in petroleum refining equipment—namely, 37,000 barrels per day for power generation at 100 per cent load factor. The throughput of coal would be 9,000 to 10,000 tons per day. With such volumes it is now reasonable to ask, might it not be better to treat the fuel for capture of its sulfur in equipment ancillary to power generation?

For oil, the answer is a clear-cut yes, and a brief survey of the situation for oil will introduce a more extended discussion of the problems of coal.

Dealing with Sulfur in Residual Oil

The advantages of dealing with the sulfur in residual oil in equipment ancillary to power generation are two:

- The refiner's task in supplying low-sulfur fuels to the small user, who cannot afford sulfur control equipment himself, is easier.
- The equipment ancillary to power generation will cost less than equipment for catalytic hydrodesulfurization at the refinery, and the thermal efficiency will be better.

Caribbean sources provide 90 per cent of the heavy oil burned on the East Coast. Without treatment, this oil normally contains about 2.1 per cent sulfur. Reducing the sulfur level to 0.3 per cent by hydrodesulfurization at the Caribbean refinery costs about $1 per barrel. But about one barrel of every four of Caribbean residual oil reaching the United States market is sold to a power company for use in generating electricity; the other three barrels are used for heating and industry. Furnishing oil at 0.3 per cent sulfur for the latter purposes would be easier if the power industry were itself geared to deal with sulfur and so could accept a residual oil containing about 3.2 per cent sulfur along with the vanadium and nickel which are so hurtful to oil hydrodesulfurization catalysts. A rough estimate indicates that the incremental cost to remove sulfur from three barrels, providing the fourth barrel could be shipped at 3.2 per cent sulfur, would be about 50 cents per barrel, or about half the cost per barrel to remove sulfur from all four barrels.

An exciting experiment is underway at the laboratories of British Esso at Abingdon, England. Oil is gasified in the presence of particles of lime (CaO) at about 850°C., and sulfur becomes fixed to the lime in the form of calcium sulfide (CaS). The yield is a sulfur-free fuel gas having a higher heating value of about 230 B.t.u. per cubic foot; the CaS is regenerated to lime by a roast at about 1050°C., expelling SO_2 at a concentration of about 8 per cent in roast gases, from which it may be converted to sulfuric acid, or, preferably, to elemental sulfur. Esso's concept is that oil-fired boilers would be modified by installation of a fluidized gasification bed in which this oil-lime reaction could take place in the lower part of the firebox. The fuel gas emerging from the fluidized bed would be consumed in a secondary combustion above the bed.

The experiment at Abingdon is at a scale that is equivalent to fuel for 1,000 kw., and a striking feature of the plan is that equipment for the experiment at this scale costs only $12,000, or $12/kw. Although this

The use of linked gas and steam turbines as an efficient source of baseload power, fueled by coal or oil, will require technology for generating clean, hot gas at high temperature from these dirty fuels. The elimination of sulfur—ordinarily difficult—fits relatively easily into such a technology.

does not include equipment for disposition of SO_2 generated in the roast, it appears that an installation on a large scale, including such equipment, ought to cost well below $13/kw., the figure for hydrodesulfurization of Caribbean oil at the refinery.

Abingdon hopes to extend its work to experiments at high pressure appropriate to supply a fuel gas to a gas turbine, for it recognizes that gas turbines are inherently cheaper power plants, even in relatively small sizes, than steam power installations. For example, a gas turbine for 50 Mw. typically costs about $90/kw., including the alternator. Even a gas- or oil-fired steam plant costs much more, and coal-fired equipment is now coming in at well above $200/kw. except in the very largest sizes.

Gas-Turbine Power Generators

It is clear that gas turbines are about to emerge as a principal successor to steam turbines for driving large, baseload power generators. A gas turbine standing by itself does not have thermal efficiency appropriate for use to provide baseload power. Most gas turbines used by the power industry in the U.S. are in peakload service, burning expensive, clean fuels. In such service, there is little incentive to put to use the heat in the hot gases discharged by the turbine. In baseload service, however, a waste heat boiler may be provided to utilize the turbine's exhaust heat for the production of steam. Even with today's gas turbine designs, the resulting combination of gas and steam turbines can provide power at a fuel consumption about 5 per cent below that of an ordinary steam plant without the gas turbine. A few installations of this type have been built to run on natural gas, but use of the combination to operate on oil or coal has been inhibited by the absence of technology for generating a clean, hot gas at high pressure from these dirty fuels.

Aircraft of current design operate with turbine-inlet temperatures near 1200°C. during take-off, and temperatures during cruising operation are not much less. Recent land-based gas turbines for baseload operation use a temperature around 900°C. Following a recent study for the Environmental Protection Agency, United Aircraft Corp. foresees no bar to continued increases in operating temperatures of land-based machines; indeed, the firm states that temperatures can be quickly pushed to levels well beyond 1200°C. Combinations of gas and steam turbines affording efficiencies of fuel-to-electricity conversion on the order of 50 per cent are envisioned within 15 to 20 years. Efficiencies now run in the neighborhood of 38 per cent to 40 per cent, and the 10 per cent increase in efficiency would reduce fuel consumption by 20 per cent. These increases in efficiency mean that the quantity of heat to be rejected to cooling water is sharply reduced in a station using a combination of gas and steam turbines.

The forecast increase in turbine inlet temperature will create a strong incentive to learn how to fire gas turbines with dirty fuels. This incentive would be present even if sulfur pollution were not an issue. But elimination of sulfur, which—as we have seen—is difficult for conventional fuels, turns out to be relatively easy as a feature of processes to generate clean hot gas at high pressure for admission to a turbine.

United Aircraft also believes the nitrogen oxide emissions from a gas turbine can be brought below 1 part per million if a lean fuel gas, resembling producer gas in having a relatively high content of nitrogen, is furnished. The flameburst temperature for a lean gas is several hundred degrees lower than for a rich fuel, and the NO_x is correspondingly reduced.

Dealing with Sulfur in Coal

Of all techniques for dealing with sulfur in coal (including the removal of sulfur by stack-gas scrubbing), the farthest along is a development of the German firm Lurgi. This process combines the gasification of coal by air and steam in the historic Lurgi gasifier, followed by power generation by a combination of gas and steam turbines. Lurgi is building in West Germany a pioneering 170-Mw. plant of this type, which beautifully illustrates the economies inherent in the combination of gas and steam turbines for power generation. The power equipment will cost $71/kw. and the gasification equipment will cost $19/kw., for a total of $90/kw.—a remarkably low price for a coal-fired plant as small as 170 Mw. The plant will consume coal of low sulfur content, and it will not include equipment to absorb the sulfur which will be present as hydrogen sulfide (H_2S) in the gas prior to combustion. Such equipment could be added for about $13/kw., making a total of about $32/kw. for gasification and gas cleaning. The total capital cost of about $103/kw., including equipment to capture sulfur, would still fall below the cost for a conventional station burning coal without means for suppressing sulfur emissions.

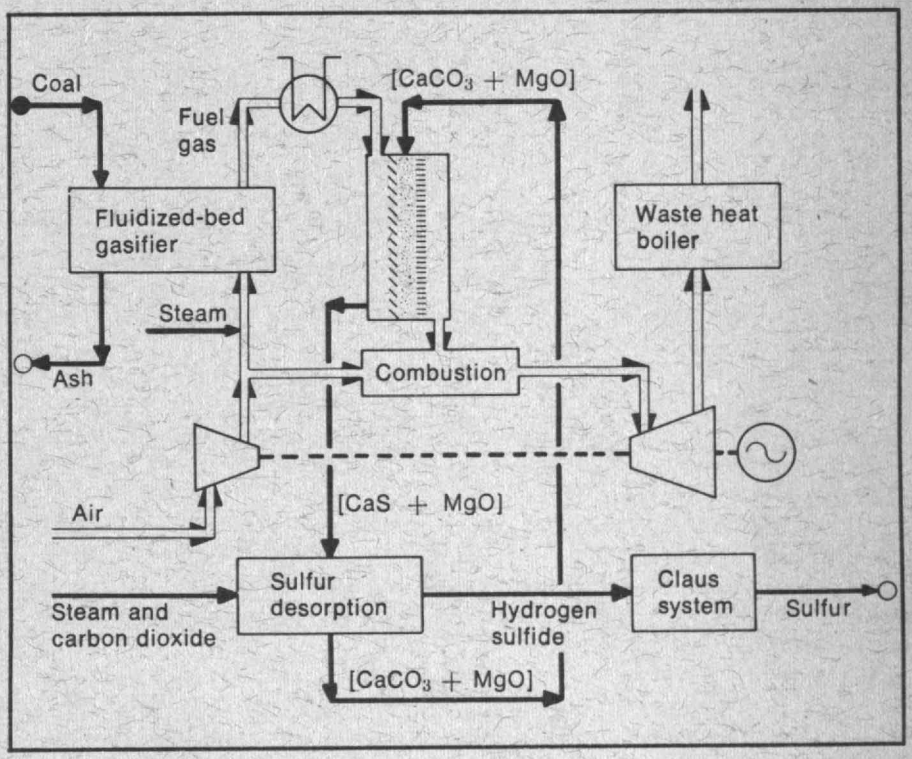
The lower cost of power equipment combining gas and steam turbines

more than offsets the extra cost of equipment for converting coal into a clean fuel gas. This is obviously an important conclusion; it attains tremendous importance, however, when there is added the fact that the combination of gas and steam turbines promises efficiencies on the order of 50 per cent as materials are developed to permit gas-turbine inlet temperatures to rise above 1200°C.

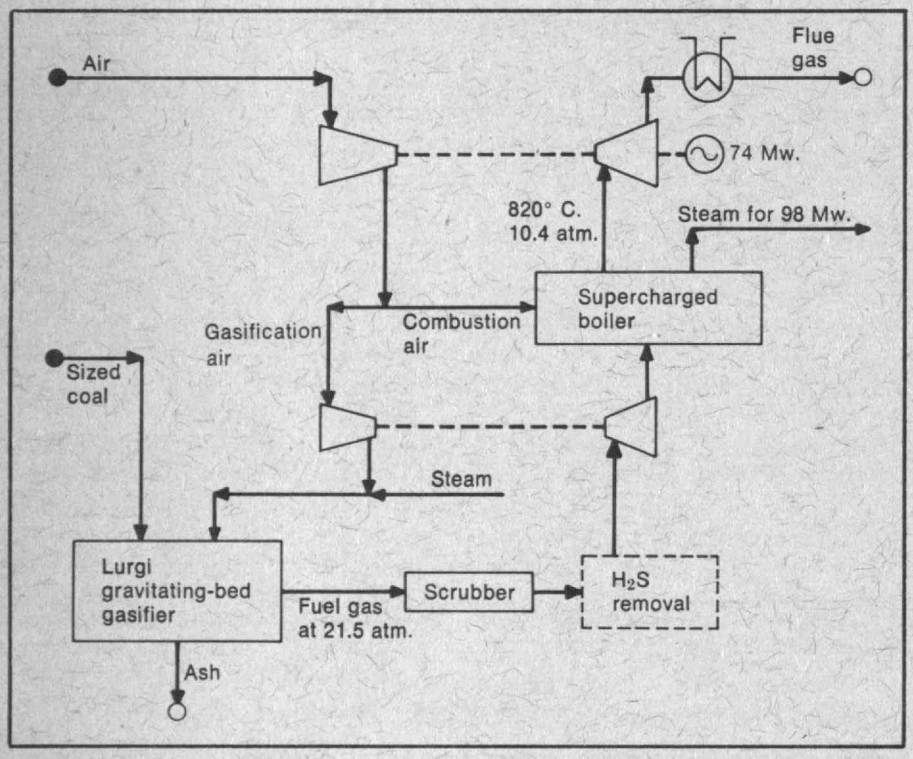
The Lurgi plan does not appear attractive, however, for the large generating plants and high labor rates characteristic of the United States. The 170-Mw. installation now under construction includes five coal-gasification vessels, each of which requires a large flow of steam in order to keep the temperature low at the combustion horizon, so that the gasifier may discharge its ash as a "dry," unagglomerated powder. This high flow of steam leads to a high rate of heat loss through the power-station stack which would be better avoided. Manpower requirements of the Lurgi system are high, both for operation and maintenance.

Thus there is now a great incentive to find a gasification technique more suitable for installation in large-scale plants which avoids the Lurgi's latent heat loss and high maintenance requirements. There are a number of possibilities, and it is much too early to pick a single, sure winner.

Much work was done between about 1945 and 1960 on gasifiers in which a dilute suspension of coal was reacted with steam and oxygen or air. A few units operating at atmospheric pressure were run commercially for a short time, and tests were conducted at elevated pressure. Unfortunately, the general conclusion from this work is that a suspension gasifier operating even at



Power generation by combined-cycle system, incorporating a fluidized-bed gasifier for coal and a panel bed filter to suppress fume and sulfur, is conceived by engineers at The City College of New York. Fuel gas from a fluidized bed gasifier is cleaned of sulfur and burned at high temperature to power a gas turbine, whose waste heat will in turn power a conventional steam-boiler and turbine. Half-calcined dolomite is used to remove sulfur from the fuel gas and is later reconstituted and reused, the sulfur being eliminated as H_2S.



This flow diagram shows the Lurgi installation at Lünen, Germany, scheduled to operate in 1972. Coal is converted into high-pressure gas by reaction with air and steam in the Lurgi gasifier, which feeds a supercharged boiler. This boiler delivers high-pressure gas at 840° C. for a gas turbine generator producing 74 Mw.; lower-level heat from the boiler, in the form of steam, is also utilized for a conventional steam-powered generator producing 98 Mw. It is this dual utilization of high- and lower-level heat which gives the gas-steam combination plant the potential for efficiencies as high as 50 per cent.

high pressure is probably not capable of providing gas with an efficiency of carbon burnup sufficient to meet the economic requirements of the power industry. Also, this gasifier is not capable of completely utilizing the steam fed to it, and so—like the Lurgi—it also leads to a loss of latent heat through steam passing to the stack.

The earliest commercial application of the fluidized bed was the historic Winkler gasifier operating on lignite. In this gasifier, a bed of pulverized fuel is kept in suspension by a rising current of steam and oxygen. Much work was done in the period between 1945 and 1960 with fluidized beds operating at temperatures up to about 950° C. At Hydrocarbon Research, Inc., I participated in a large test at elevated pressure using fine residues from the mining of Pennsylvania anthracite. Experience with the Winkler and the post-World-War-II studies indicate that a fluidized-bed gasifier at temperatures to 950° C., like the dilute-suspension unit, inherently cannot achieve adequate carbon burnup nor provide complete utilization of steam.

Meanwhile, Albert Godel, working in France to develop his Ignifluid boiler during the 1950's, made the important discovery that ash of substantially all coals is self-adhering at a temperature in the vicinity of 1100°C. His Ignifluid boiler exploits this discovery to gasify an extremely wide range of coals in a fluidized bed resting upon a traveling grate. Coal is supplied in sizes up to ¾ inch, and ash is released as each coal particle is consumed. Ash sticks to ash and not to coal, agglomerating and sinking to the moving grate which carries the waste to an ash pit. Fuel gas produced in the

There is a good chance that a fluidized-bed coal-gasifier can be developed having very small losses of heat and unprocessed fuel. Such a gasifier can be incorporated into a unified fuel-to-power plant in which the sulfur and dust is drawn off prior to combustion.

gasification bed is burned in a secondary combustion above the bed. For most coals, substantially complete carbon burn-up is achieved simply by returning particles carried out of the boiler to the bed. Such particles are relatively coarse, and are easy to collect.

F. J. Dent, one of the great development engineers of the past generation who was for many years Director of the British Gas Council's experiment station at Solihull, discovered that, while a fixed-bed reactor operating at 1100° C. furnishes an offgas which falls far short of equilibrium, a fluidized bed operating at this temperature attains the steam-carbon equilibrium. The practical effect is that the fluidized-bed gasifier can achieve substantially complete reaction of all the steam fed to the unit.

These kinetic facts urge the development of an ash-agglomerating fluidized-bed gasifier for operation at 1100°C. and elevated pressure. There is a good chance that it can provide substantially complete utilization of all steam and carbon fed to it, thereby keeping latent heat losses to the stack and losses of unburned fuel to a minimum.

Such a gasifier can be incorporated into a unified fuel-to-power plant in which the sulfur and dust from the fuel is drawn off in a panel bed filter prior to combustion.

This filter uses a granular solid derived from dolomite as an advantageous reagent for removal of sulfur from the fuel gas; the solid can be arranged in a panel bed filter allowing it to serve simultaneously as a filter to remove dust. Dolomite is the double carbonate of magnesium and calcium, $CaCO_3 \cdot MgCO_3$, and is a true chemical species. A research team at The City College is finding that half-calcined dolomite, $[CaCO_3+MgO]$, formed by heating dolomite to about 800° C. and decomposing $MgCO_3$ in the original material, is extraordinarily reactive toward hydrogen sulfide (H_2S), although limestone ($CaCO_3$) is almost completely unreactive. The reactivity of half-calcined dolomite can be understood when it is appreciated that this solid is an intermingling of microscopic crystallites of $CaCO_3$ and MgO. The reactivity of the crystallites of $CaCO_3$ in half-calcined dolomite is explicable in light of their small size and their accessibility to gas because of the porosity created by the presence of the MgO crystallites. The reaction is:

$$[CaCO_3+MgO] + H_2S = [CaS+MgO] + H_2O + CO_2$$

This reaction can readily be conducted in reverse, to later desorb H_2S from the calcium sulfide (CaS). The H_2S can then be converted to elemental sulfur by well-known techniques.

The City College research team has found that a panel bed filter, if operated at relatively low velocities, below about 20 feet per minute, can be highly efficient in removing dust and fume as well as sulfur. Filtration efficiencies beyond 99.9 per cent for a monodisperse aerosol of 1.1-micron particles have been observed.

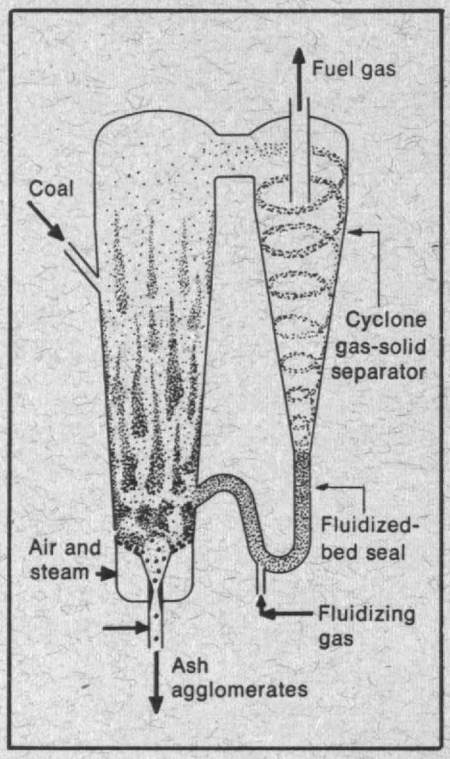
Other Possibilities Deserving Attention

Another attractive idea is to pyrolyze (decompose with heat) fuel at about 700° to 800° C. and elevated pressure in presence of both hydrogen and calcined dolomite, [CaO + MgO]. The hydrogen helps to free sulfur from the fuel, including the coke product, and the calcined dolomite accepts sulfur from H_2S which is formed in the pyrolysis.

The City College team has proposed a technique for cracking residual oil at around 700° C. and elevated pressure to yield three products low in sulfur: a light oil, pea-size coke pellets, and a rich fuel gas (540 B.t.u./cu. ft.), each in a quantity amounting to about one-fifth of the heating value of the oil. The remaining heating value would be available as by-product heat or as a lean fuel gas, low in sulfur, to be used promptly for power generation. An advantage of the technique is that the oil-processing equipment can operate steadily, with the light oil and coke being sent to storage while the station served by this equipment and burning the rich fuel gas is turned down in capacity during periods of low demand.

A comparable process for coal is also visualized, yielding approximately two-thirds of the coal's heating value in form of low-sulfur, pea-size coke pellets. The coke might be crushed and burned in existing coal-fired boilers along with some low-sulfur oil to stabilize the flame, or it might be gasified to supply fuel gas to a combination of gas and steam turbines.

An experiment recently underway at BCURA Industrial Laboratories at Leatherhead, England, should be mentioned. Here coal was burned completely, in one step, in a fluidized bed operating at 800°C. and at elevated pressure. The concept is that offgases from the bed shall enter a gas turbine. Boiler tubes pass through the bed to remove about 70 per cent of the coal's heating value to steam. Experiments in which dolomite was injected to capture sulfur gave strikingly better results than similar experiments con-



This design for an ash-agglomerating gasifier exploits the recirculating fluidized bed developed by Lurgi to gasify carbon fines released as a large coal particle wastes away, and it uses a "valve" for ash agglomerates at the bottom, demonstrated by Jequier and his collaborators at Centre D'Etudes et Recherches des Charbonnages de France. Another possibility would be a standpipe carrying ash agglomerates away from the gasification bed and fitted with a rotating grate at the bottom. The fluidization velocity would be about 10 ft./sec., and a single vessel could readily handle enough coal for a 1,000 Mw. generator.

ducted at atmospheric pressure.

The Leatherhead experiment must be viewed as opening up a serious possibility for equipment valuable for the middle term. Over the long term, schemes based upon gasification or pyrolysis have greater appeal, since only they can permit full utilization of the higher efficiency and lower cost of combinations of gas and steam turbines expected to arise as gas-turbine temperatures advance. The latter schemes, too, have the advantage that gas volumes are significantly smaller in the coal-processing step during which sulfur is captured.

As noted earlier, equipment for gasification and gas cleaning for an installation using Lurgi gravitating-bed gasifiers will cost about $32 per kilowatt in German funds. In view of the small scale of this equipment, it is reasonable to hope that a gasifier or equipment for pyrolysis on a large scale can come in at a cost well below $30, most probably even below $20. United Aircraft has projected costs below $25/kw. for advanced gas turbines on the 300-Mw. scale. Such a turbine would supply more than half of the total power produced by an advanced system which includes both gas and steam turbines. The economic incentive to develop such systems to work on coal and oil is obvious.

It does not appear that independent processes for reducing coal to a clean fuel such as "solvent-refined coal" can compete with coal treatment which is ancillary to power generation itself. Work on the independent processes may well be justified with the aim of providing low-sulfur fuels to small customers unable to provide means for sulfur control, although it seems quite unlikely that low-sulfur fuels can be

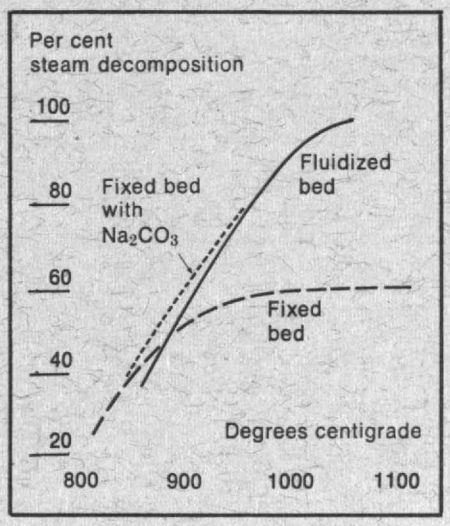
A power station generating electricity by a combination of gas and steam turbines affords the chemical engineer an advantageous new setting for conducting a wide variety of chemical alterations. With rising costs of energy, the synergism afforded by combinations of power and processing equipment will be better appreciated.

furnished such customers from coal as cheaply as from residual oil. This will be particularly true if the power industry relieves the oil refiner of his worst materials, the dregs remaining from a deep vacuum distillation.

Recipe for Invention

A power station generating electricity by a combination of gas and steam turbines affords the chemical engineer with an advantageous new setting for processing fuels, or indeed for conducting a wide variety of chemical alterations. With the rising costs of energy which most economists now predict, the synergism afforded by combinations of power and processing equipment will be better appreciated. The power station of the future will afford the chemical engineer with air at high pressure for process use at substantially negligible cost. Heat put into the air during its compression is perfectly good heat for the power cycle. The chemical process may freely generate a lean fuel gas, even a gas of low calorific value, since the gas can be consumed at the gas turbine; or the process can throw off a combustion product gas at high pressure. The process may freely discharge heat at temperature levels above about 400°C., since the heat can be used to raise prime steam. Limited amounts of heat may be discharged freely at temperatures even below 400°C. These new rules in respect to rejection of heat open up a wide range of new high-temperature chemistries for process use, which cannot now be considered because heat rejections at high levels are too costly in the normal processing context.

Of course none of this will come about without effort. Much more money is needed for research and development upon coal and even upon residual oil than government and industry have seen fit to devote to these activities in the past 25 years. It is ridiculous that the funding of work on coal has been at an annual level less than 5 per cent of the cost of a single moon shot. Talent follows money, and the problems of fossil fuel—need for lower costs to remain competitive and need to suppress emissions of pollutants—will not be solved until they receive adequate attention.



The steam-carbon reaction proceeds to only 60 per cent completion in a fixed-bed reactor. But with sodium carbonate to catalyze the reaction, apparently by inhibiting the "graphitization" of the surface of the carbon, the reaction of steam and carbon proceeds substantially to completion. A fluidized bed has the same effect, since each particle of carbon passes periodically through a zone near the bottom which is high in steam and low in hydrogen—conditions which promote carbon reactivity.

Extracts
from a research report by Fred L. Robson and Albert J. Giramonti of United Aircraft Research Laboratories

Increasing Gas Turbine Outputs for Combined Gas/Steam Systems

One of the most promising advanced-cycle power systems consists of a combined gas-turbine/steam-turbine (COGAS) system in which the hot exhaust of the gas turbine is used to raise steam in an unfired waste-heat-recovery boiler. The gas turbine used in this system would be an evolution of current turbomachinery and would utilize aerodynamic and blade cooling concepts and blade materials which are now used or proposed for advanced aircraft gas turbines.

Using technology judged to be available by 1980, the COGAS system could achieve overall station efficiencies of approximately 55 per cent, with the potential of even higher efficiencies with more advanced technology. Thus power systems incorporating advanced-design industrial gas turbines used in combination with steam turbines offer the potential of generating power at costs significantly less than those presently encountered or projected for future steam stations.

The majority of industrial gas turbines now being manufactured are based upon technology initially developed for industrial compressors and steam turbines. These machines are rugged and very heavy. On the other hand, aircraft-type gas turbines are generally designed for high power density, light weight, quick startup capability, and short installation time. Existing differences between design philosophies for these two classes of gas turbines will diminish as a result of continuing efforts to improve the thermal efficiency of industrial gas turbines.

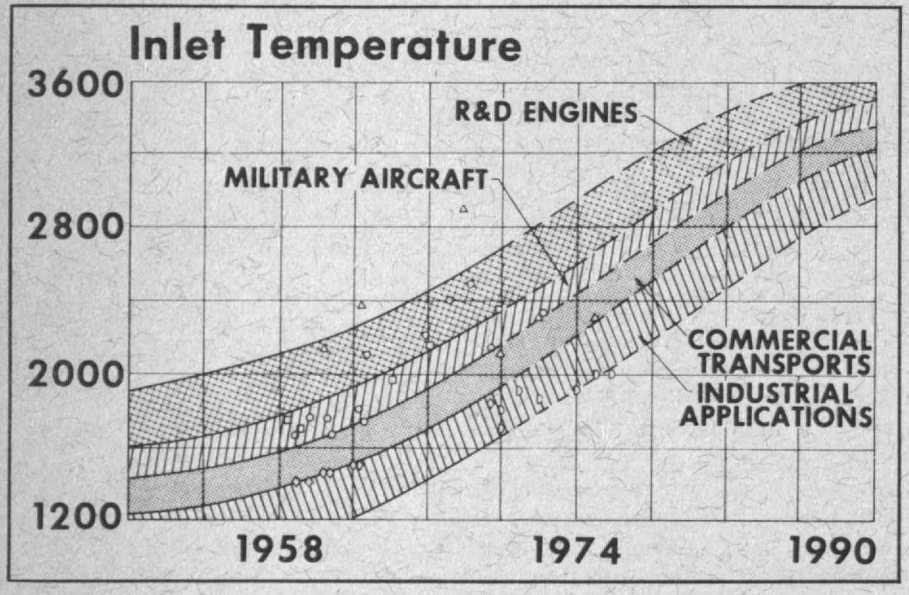
By adapting recent and continuing advances in aerospace technology to industrial turbomachinery, substantially improved large capacity, simple-cycle gas-turbine power systems with appreciably higher thermal efficiencies could be achieved, leading to their widespread use in base-load power generation applications.

Recent advances in aerospace technology were achieved during extensive research and development efforts on military and commercial aircraft gas turbines and include improvements in materials technology, blade cooling techniques, aerodynamic flow path design, high-heat-release burners, and modular fabrication techniques. While meaningful improvements in aerodynamic performance are projected for future gas turbines, the most significant increases in gas turbine performance will result from increases in turbine inlet temperature. These increased temperatures will be a direct result of improvements in materials and blade cooling techniques.

Turbine blade materials for the second-generation gas turbines (available during the 1980's) will include nickel-base alloys and solidified eutectic alloys such as Ni_3Al-Ni_3Cb currently under development for advanced high-temperature aircraft turbines. Although an accurate prediction of third-generation (1990's) materials properties is difficult, it is reasonable to assume that chromium and columbium-type materials currently being investigated will be used.

Currently, only the first-stage vanes and disks of industrial gas turbines are cooled. This cooling is presently accomplished by means of air extracted from the compressor and injected directly into the turbine sections to be cooled. It will be necessary to cool successive stages of blades and vanes if long-life operation at high turbine inlet temperature is to be realized. But the use of such advanced cooling techniques should allow second-generation base-load turbine operation at turbine inlet temperatures as high as 2400° F., leading to gas turbines with high performance and increased output per engine.

In addition to these increases to be realized in gas turbine power outputs, power system efficiencies would be further improved if the large amount of high-grade heat in the gas turbine exhaust were recovered. For example, studies indicate that the temperature of the exit gas from a high-temperature gas turbine generator might be over 1100° F., so that steam at 1000° F. and 2400 lbs./sq. in. could be raised for use in a steam boiler without firing the boiler. The gas turbine would supply approximately 60 per cent of the total system power, the unfired steam turbine 40 per cent.



Fred L. Robson and Albert J. Giramonti of United Aircraft Research Laboratories predict that technological advances in gas turbine materials and blade cooling techniques will allow turbine inlet temperatures—now about 2800° F. in the most advanced research and development machines—as high as 3600° F. by 1990. As advances based upon this technology are adapted for industrial machinery, turbine inlet temperatures of over 2800° F. may be foreseen for central-station gas turbines before the year 2000. The result will be higher efficiency. Though the gap between research and commercial applications is closing, the authors warn that "the projected increases in turbine performance are going to be expensive."

CONTROL OF CLIMATE BY MAN IS FORECAST

UNITED NATIONS, N. Y. (AP) — The seas won't come crashing in on us, but man's heat-producing activities can change the climate.

A new study sees a "real possibility" that growing demands for energy could melt or reduce the Arctic sea ice, causing unpredictable changes within a century.

There are no doomsday prophecies in the study, however, and the 30 atmospheric scientists did not predict the melting of the polar ice cap itself, which would raise sea levels by many feet, as studies have predicted.

Until further knowledge is obtained on man's impact on climate, they recommend that countries hold off large-scale experiments in modifying the climate.

The scientists reached the conclusions during a meeting in Stockholm. The Massachusetts Institute of Technology has published their report and it was sent to the committee preparing for the U. N. Conference on the Human Environment next June in Stockholm.

Dr. Carroll L. Wilson, an M.I.T. professor who directed the study, said that input from such things as oil, coal and nuclear energy helps heat up the globe.

Most of the increase in heat input is occurring in the north-

The summary chapter of the study described in this Associated Press (New York Times) story is available from the Editors as a supplement to Technology Review.

For your copy, clip this ad, write your name and address in the margin, and send it with 50¢ (48¢ in stamps) to us at Room E19-430, M.I.T., Cambridge, Mass., 02139.

Trend of Affairs

Trends This Month

ENVIRONMENT

An institutional vacuum on social costs . . . Dry papermaking . . . Fly ash as soil conditioner . . . A creature-bank . . . Sewage treatment with waste heat.

NUTRITION

Still no market for F.P.C. . . . Selective malnutrition among refugees.

COMPUTERS AND SYSTEMS

The East-West computer gap seems to be widening . . . and so is the gap between systems analysis and reality . . . Operations research, professional standards, and a missile . . . Privacy and the world's largest computer system.

TRANSPORTATION

Enter the Magneplane, flying low on a moving magnetic field.

ECONOMICS

Four views of the new rules.

EDUCATION

The real problems of technological education, as recorded by the President of M.I.T. . . . and some supernatural ones as recorded by some students.

OCEANS

Can we mine the $2.5 billion of Red Sea ores? . . . A survey of America's unemployed submarines . . . Dealing with oil spills the natural way.

RATES OF CHANGE

Labor efficiency up five-fold in 85 years . . . Short-lived phenomena in 1970, including 16 oil spills, 15 astrophysical events, and some urgent anthropology.

NUCLEAR

Geothermal power by nuclear explosion . . . A new study of the public vs. the reactor.

ENVIRONMENT

The Hidden Debit Sheet

The City of Chicago pays about $200,000 a year to clean walls which have been defaced with paint spray cans. Nationwide, this task probably costs something of the same order as the total takings of the paint spray-can industry. The industry thrives because the convenience of the device is judged by legitimate users to be worth its selling price. But that price does not include the cost to society of placing such a tool in the hands of the wall-scribbler (who is always with us).

This is a simple example of an industrial activity having an "external" cost which is not reckoned in the conventional budgeting of that activity. It was used by a speaker at the Engineering Foundation's summer conference on Engineering and Social Costs in Environmental Control, to make the point that there are indeed costs which, though quite real and measurable, are not on the usual balance-sheets: and that it is important to "internalize" these hidden costs—to place them alongside the direct costs—so that consumers and voters are not misled by false economies.

The conference was attended by about 35 industrial engineers, engineering consultants, academics, and government officials. Like all Engineering Foundation conferences (of which there were 16 this summer) it was off-the-record, for the sake of frankness of interchange. And indeed, as the week progressed, the initial tendency to regard attendees from major corporations as company spokesmen was successfully overcome. That the tendency had existed at all was, however, a powerful reminder of the plight of the ordinary citizen in search of credible expert advice.

Very early, the question arose as to whether or not every social cost could be expressed in economic terms. Social costs include (in fact or potentially) various kinds of pollution, aesthetic offenses, risks of injury and death, and in general the modification of every facet of human life. One speaker suggested that the reason we value good antiques is that they possess qualities which are not to be found in contemporary industrial products; they "*emanate* pride, skill and care *at us*," he said, and asked whether a dollar value could be assigned to these qualities. Another of this school placed no economic value less than infinity upon his own survival. But the pure-economics faction held that if there was anything in life whose value could not be reduced to a figure, it was up to the opposition to prove it. The debate was heated, the opposed forces seemingly unshakeable.

However, in workshop studies of particular cases it appeared that social costs of many activities could in fact be quantified with remarkably little disagreement. For example, one group costed about 90 different social impacts of U.S. automobile pollution, and came up with an answer not unlike those published in existing literature: $100 per car per year, of which two-thirds was due to the effects of air pollution on people and the remainder due almost entirely to—in descending order—the human effects of noise, the unsightliness of scrapheaps, the effects of air pollutants on the natural environment, and of air pollution on structures.

Where to Send the Bill?

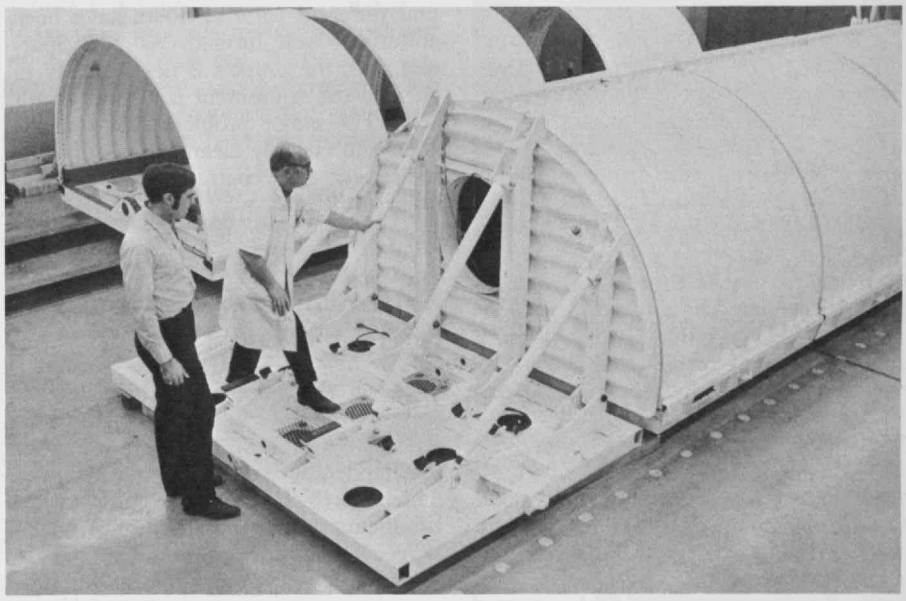
But having weighed the costs—of the various power sources, of domestic appliances designed for short life and not for easy repair, of convenient throw-away items—how to insert them into our political and market processes, so that future progress will be progress indeed?

As regards products such as cars, refrigerators, and the like, a favorite solution was to encourage the existing trend toward renting rather than owning, thus shifting the onus of servicing—and ultimate disposal or reuse of consti-

tuents—to the manufacturer, or at least to some large organization which can be effectively regulated. (The differences between automobiles and commercial trucks were found instructive in this connection.) An alternative would be to place the domestic repairman on a more professional basis, by government support of training leading to certification; while for the manufacturers, there would be tax incentives for repairability. Repeatedly the meeting turned its attention to "Mr. Fixit, the most important man in our society," in search of means to increase his effectiveness and lower his bills.

An entirely different set of questions arises in connection with large-scale projects. Here the natural choice-making system is political. One difficulty arises when citizens who wish to play their part in the assessment of an engineering proposal try to obtain competent technical advice. The experts who could give realism to explicit estimates of social costs (and environmental improvement, as well as industrial development, has its hidden costs) tend to be already committed—including those on university faculties, who acquire extramural loyalties with their consulting work. Many citizen groups are unable to pay for consultancy, and may even prefer unpaid volunteers as being more likely to be public-spirited; and such groups often do not realize how wide a range of expertise they need. Engineers, by and large, are in any case reluctant to become involved in politics, even when there is no danger to their careers.

The effects of this institutional vacuum are seen differently by different observers: one conference attendee remarked disdainfully that the citizen groups "will talk to anyone who comes in off the street"; but it was also noted that such real independent experts as there are tend to align themselves with the environmentalists. Thus it is that the battles between "industry" and "conservation" continue, in a mood of extreme mutual noncredibility. One suggestion was that what is lacking is a kind of technical court-house (*see "The Test" by Arthur Kantrowitz,* Technology Review, *May 1969, pp. 44-50*) conceivably provided by the professional engineering societies.



A major social cost of underground coal mining is loss of life. There are continuing efforts to reduce this cost—for example, the Westinghouse survival shelter shown here, part of a proposed system for keeping miners alive following coal-mine explosions. At the same time, there is a trend toward strip-mining, which reduces this kind of social cost (on a per-megawatt-year basis) but increases another kind—loss of land and water quality. In the U.S. there is little serious effort to reduce this second cost, which therefore generally remains both large and external to the perceived economics of fuel-winning.

The conference identified a number of other unfilled needs, including:

☐ Land-treatment standards for strip mining. In the move from underground to surface mining, the social cost of coal diminishes in terms of hazard to life and limb and increases in terms of land despoliation. The former is a cost that, to a great extent, is already paid, as a result of federal safety regulations; the latter, in general, is not.

☐ A federal agency responsible for technical progress in power-generation techniques. Techniques for raising thermal efficiency, such as M.H.D., may offer environmental (external) benefits and yet fail to justify development costs in terms of the internal budgets of the power companies.

☐ Inventories of industrial waste-streams.

☐ Quality information on the nation's water resources. At present it is not possible to estimate the cost of cleaning U.S. rivers (even given a definition of "clean"), or to know whether quality is in general improving or deteriorating.

☐ Comprehensive development planning—taking due account of resource availability and population trends—at state and local levels.

☐ Clearly available research funds and risk capital for waste-treatment innovations and other social-cost-cutting technology.

Practical Recycling: Paper

Several hundred tons of water are generally required to make one ton of paper; perhaps 50 tons cannot be cycled through the process again and are lost as vapor or as effluent. But a papermaking technique being studied at Arthur D. Little, Inc., Cambridge, uses no water at all.

In the conventional process, the water carries wood or rag fibers and lays them down into a mat as the pulp is sprayed over a moving wire screen. Some of the water drains through the screen; more is squeezed out between rollers, and the paper is finally dried by gas driers.

The Arthur D. Little work shows that the fibers can be laid down dry, carried by a stream of air. The advantages—deriving directly from the absence of water—are significant, according to Donald B. Sparrow, director of research on the project. To be economic the wet process must be used in a large plant with large capital investment, and it obviously requires also a large nearby water source and sink. A wet-process newsprint plant, for instance, must make 300 tons of paper a day—a size that would cost $20 to $24 million to build to be economic. A dry plant could be economic at 15 to 25 tons per day, and built for $1 million. Dry-process plants can be located almost anywhere—especially near a good source of waste paper, for the process works well with recycled fibers, another advantage.

Waste-paper fibers tend to be shorter—they break in processing—and to be weakened by repeated wetting and drying.

In the wet process, the first long fibers laid down form a web to catch the fibers that follow, but very short fibers can still be washed through by the water that carries them. This loss is not nearly so likely in an air-borne process, as the web is laid down in a different pattern and has an additional binder to hold it together. (Some work yet needs doing on binders that are both inexpensive and satisfactory.)

The use of binders (usually not needed with water) offers considerable flexibility in the qualities the paper will have—and could compensate for whatever strength is lost in recycling the fibers. There is also an increased flexibility in the allowable mix of fiber sources—rag, wood, or synthetic materials.

Dry-forming did not originate with Arthur D. Little; it is already in use for some nonwoven fabrics. But it is presently used with long fibers and for quite specialized products. A.D.L. envisages the process in wide use, in small plants, and particularly for recycled paper. Only eight places in the country generate enough waste paper to support a wet-forming plant to recycle it, whereas dry-process plants could be located virtually anywhere. Reduced transportation costs are an obvious saving.

Making paper dry is quite simple. Dry pulp, or paper to be reused, is held against a device that grates it into fibers. The fibers are blown in an air stream at slight pressure onto a moving wire screen. The binder is added either as a vapor in the air stream or as a spray onto the forming web of paper, depending on the product. The paper is then run through a series of rollers to compress it and through a short (by the standards of wet machines) drier.

The samples thus far made with several different sorts of fibers have been uniformly well formed. As Mr. Sparrow said, the process is nearly ready to go, and the equipment is already available. The major problem that remains is how to cheaply clean the fibers to be re-used of ink, coating materials, and other additives.

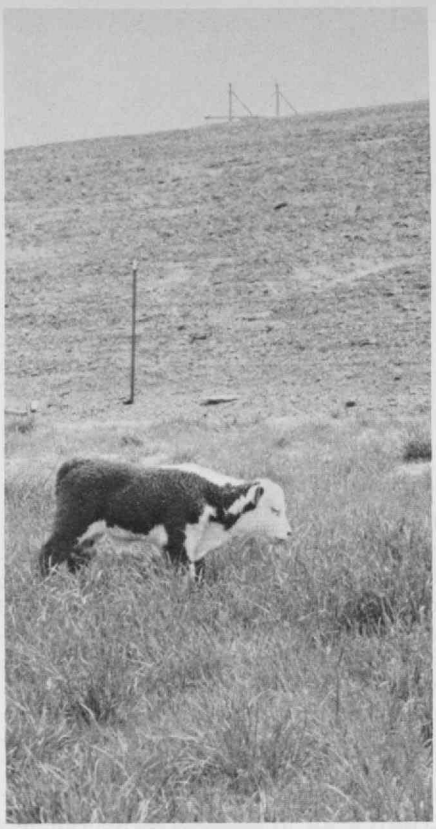
Fly Ash Goes Back to the Land

Three of the most devastating side effects of the coal industry are the barren scars which strip miners leave on the land, the huge coal refuse piles which have for years blighted coal-producing areas, and the fly ash which is recovered from power station smokestacks and heaped up in disposal sites (*see "Must Fossil Fuels Pollute?" pp. 34-43*). These effects account for the despoilation of nearly a million acres of land in the United States—and the figure climbs to well over two million if one includes land spoiled by other types of surface mining.

But a single system may contain the solution to all three problems. John P. Capp and Lester M. Adams of the U.S. Bureau of Mines' Morgantown (W. Va.) Energy Research Center have achieved encouraging results by mixing in fly ash on the surface of strip mine spoil and of coal refuse.

For practical purposes, nothing can grow on the highly acid strip mine spoil or coal refuse banks. Because they contain pyritic minerals associated with the coal and the overburden, their pH values lie mostly in the range of 2.5 to 3.5. Many fly ashes, on the other hand, are alkaline, ranging in pH from 8 to 12, and may be used much the same way as one would use lime on acid soils.

In test plots, Messers. Capp and Adams mixed fly ash into strip spoil and coal refuse, using between 150 and 800 tons of fly ash per acre. They found that the fly ash neutralized the acid soil and changed its texture to a silt loam—giving the soil greater pore volume, greater moisture availability, and higher air capacity—and hence better conditions for root penetration and growth.



Strip mining spoil in the foreground treated with fly ash supports vegetation, while untreated spoil in the background remains barren. This plot is part of an experiment conducted near Morgantown, W.Va.

After the treated soil was fertilized, certain grasses and legumes grew quite well, giving dry matter (hay) yields comparable with those from nearby undisturbed pastures and meadows. Furthermore, Mr. Capp points out, the grasses and legumes give immediate ground cover, so that erosion and the resulting stream pollution can be abated.

Conservationist Memo: U.S. to U.N.

In preparation for the conference on the human environment planned by the United Nations in Stockholm next June, the United States has, like other members, submitted a sheaf of recommendations for the Secretary-General to consider. Most of them deal with the monitoring of environmental alterations, with building models to predict them, and with educating all levels of government and the people of all

countries about man-made changes and their consequences.

Among the more interesting is the idea that each nation might preserve adequate stocks of its species of plants, trees, animals, and micro-organisms to ensure that no genetic characteristics were lost (because the extinction of any variant of a species limits the possibilities available to future breeders contending with problems yet unimagined). The practice could be unwieldy, the report notes: a population sufficient to preserve a properly varied group of buffalo, for example, would be 100. And complicated: among micro-organisms, some 100,000 species of fungi exist, 1500 of bacteria, 18,000 of algae, and 20,000 of protozoa. (70,000 micro-organism species are already held in collections around the world.) There are 300,000 species of higher plants, only 600 of which have been important to man; just 15 of them now feed most of mankind. This specialization worries the advisory council, because it means a loss of adaptability.

The suggestions include a number of specific proposals for U.N.-supported research "of major international benefit." Half of urban waste, and more than half of agricultural waste, is cellulose, which could perhaps be used to grow single-cell fungi and bacteria as a source of protein—research is needed to make protein from this source economically competitive. The U.N. might also support work on the side-effects of large dams (including the problems of resettling people); and on the effects of urbanization in developing countries where cities grow at twice the rate of overall population growth.

A final suggestion is the creation of a World Heritage Trust, with sufficient funds to save for the whole world such areas as are of "such unique worldwide value that they should be treated as part of the heritage of all mankind and accorded special recognition."

Utilizing Waste Heat

Several efforts have been made to design new cities or industrial complexes to make use of waste heat from electric generating stations (*see, for example, "Heat—The Ultimate Waste," pp. 44-51, or "Must Fossil Fuels Pollute?" pp. 34-43*). A particularly imaginative, though technically informal, proposal was published late last summer by an Associate Professor of Urban Design and an Associate Professor of Nuclear and Ocean Engineering at the University of Rhode Island.

The authors, Dieter Hammerschlag and Dr. Vincent C. Rose, began with the assumption that a nuclear generating facility will be built near Rome Point on the shore of the Narragansett Bay south of Wickford, R.I. Their problem was to plan related facilities which could make use of waste heat from the reactors and thus increase the total benefit of the project.

Before proceeding any further, however, they had to deal with the temperature problem. If the generating system is to operate with any kind of thermal efficiency, the coolant has to be discharged at as low a temperature as possible. In practice, this usually means 95°F. or below. But uses for large quantities of water at that temperature are very rare; if heat is to be used efficiently, it has to be available in high-temperature forms.

The Rhode Island team believes it might pay to operate the reactor at reduced thermal efficiency but at the same time produce usably hot effluent at a lower price per B.t.u. than any competitive heat source. "Hence," they explain, "an economically favorable tradeoff between heat and power may result."

They surveyed several possible uses and combinations of uses of waste heat for applicability to the specific location. The products and processes they considered involved marine pharmaceuticals, aquaculture, bromine, chlorine and caustic soda, sewage treatment, organic fertilizers, plastics, heating and refrigeration (for residential and recreational use), food processing (including brewing and distilling), paper, synthetic fibers, soap and glycerin, and petroleum refining.

Their analysis led them to pick sewage treatment as the most promising principal use. It is non-seasonal and fits nicely into the scheme of regional needs—more clean water and less sewage. The proposed system would consist of primary, secondary, and tertiary treatment facilities, each using heat to increase process rates. Sewage from the entire Providence metropolitan area would be piped into the facility, and its entire water output would be piped back into the city's reservoirs. Cost of the project, including pipelines, pumping stations, and incremental cost of the extra power plant capacity, is estimated at $74.3 million.

Perhaps because one of them is an urban designer, the authors propose that the sewage treatment facility be accompanied by (oddly enough) a new residential community—and that some of the nuclear reactor's heat output be used for heating and cooling of the residential complex.

"It has often been stated," the authors repeat, "that the bay is [Rhode Island's] greatest natural resource." To enable their new community to make optimum use of the bay, they propose to build the entire complex on three adjacent artificial multi-tiered islands. The lowest level would support marinas, parking, and land recreational facilities, and be surmounted by 10 to 15 successively smaller rings of housing. The artificial islands would partially justify their cost by serving as bases for a new bridge which the authors expect to be needed within a few years—and which would gracefully skim the smallest rings of housing as it traversed the bay.

Although the authors give no cost figures for the new estuarine community, they point out that it can be built with the exclusive use of existing technology. Furthermore, the reactor upstream of the town would almost gratuitously cook its sewage, heat and cool its rings of housing, and warm its watery environment with the unused portions of waste heat.

Professor Dieter Hammerschlag of the University of Rhode Island's Department of Urban Planning reviews a development plan centering on a proposed nuclear generating station. Waste heat utilization is the plan's main feature.

Cheap Protein: Still Not Cheap

There is a plant at Canso, Nova Scotia, that makes fish-protein concentrate—an industry which the town needs and is determined to make successful. It takes 6.6 pounds of whole fish to make one pound of F.P.C., and therein is the problem—to make money, the plant must operate most of the year, and pay average yearly rather than seasonal prices for its fish.

Fish-protein concentrate (F.P.C.) is a supplementary protein food. As such, it competes with soy and other oilseed proteins. (Other suggested protein sources—leaf concentrate, micro-organisms—are still under development.)

The plant at Canso can produce 30 tons a day (using 200 tons of fish), and cost $5 million to build. Capital costs are somewhat under 20 per cent of the price per pound, a reasonable figure, unless the plant is used for considerably fewer days per year than the 260 expected. A study of F.P.C. economics, written by John W. Devanney, III, and Glen Mahnken of the M.I.T. Department of Ocean Engineering reports that F.P.C. made from fish bought at 1¢ per pound will likely cost 23¢ per pound; fish at 2¢ per pound, 29¢; at 3¢, 36¢; and at 4¢, 43¢. The Canso plant expects to charge 35¢ per pound.

Hake is the cheapest ground fish that might be used, and it is now eaten with relish in Europe, whole. Its cost is rising, and is at least 3¢ per pound. The oily fishes, herring and the like, are cheaper, but harder to transport and irregularly fished. They can be had for less than 2¢ a pound, but the supply is less dependable. The Canso plant counts on getting one-third of its raw material in trimmings from a fish processing plant next door, at 1¢ per pound, which will make its operation somewhat cheaper, and if it can make one-third of its F.P.C. at the price permitted by that source, Dr. Devanney said, it might meet its target of 35¢ per pound overall.

Another F.P.C. plant is planned for Baja, California by another group, also a 200-ton ton facility. Fish is cheaper on that coast—hake can be had for about 1¢ per pound and anchovy for less—as is labor (from Mexico). Supplies of fish are more dependable, and the product will cost, its producers feel, about 25¢ per pound.

The authors caution, however, that the Agency for International Development had a contract out for 1000 tons of hake-based F.P.C. at 42¢ a pound, which the contractor could not fulfill.

Suggestions are common that the Federal government should somehow support F.P.C. development to stimulate a depressed fishing industry. The authors feel that more direct means of stimulation are possible, and, countering the argument that other foods are subsidized, add: "The fact that the government makes diseconomic investments in one area is no reason to make a similar investment in another area." However, research on F.P.C. might well be supported as a public good.

A simple stimulus to the industry might come from lifting the restrictions placed by the F.D.A. on selling F.P.C.: it cannot be sold in packages less than one pound, a burden the authors feel removes it from the home-use market. It must also be hake-based, which increases the cost. The one-pound requirement is to prevent the consumer from ingesting it without knowing: "the F.D.A. has the responsibility of preventing people from eating voluntarily unknown, beneficial ingredients." The F.D.A. argues, the report says, "by analogy, that if they were to accept F.P.C. as an additive, they would have to accept a bacteria-free, stable, nutritious supplement made out of, say, whole rat. We suggest that with suitable labeling this is indeed the case. Whether or not people found such a product distasteful could be made quickly evident in the marketplace." They conclude that the final test of acceptability should be left to the people.

Overwhelmed by Malnutrition

"One can only comprehend the magnitude of the situation by seeing it first hand . . . you have to see it and experience it and smell it. I had thought I was prepared to see malnutrition, [having seen it many times before], but I was overwhelmed by the situation I found." Dr. Nevin S. Scrimshaw, head of M.I.T.'s Department of Nutrition and Food Science, has spent most of his life studying the problems of malnutrition in many parts of the world. But this is how he describes the refugee camps in northeast India.

Dr. Scrimshaw made an inspection tour of the refugee camps last August as representative of the World Health Organization and of UNICEF; he accompanied Senator Edward M. Kennedy, Chairman of the Senate's Subcommittee on Refugees.

In a typical camp, Dr. Scrimshaw told an M.I.T. seminar on his return, 2,000 people are crowded together in rudimentary shelters which give each family an average of about five square feet and have no sanitary facilities of any kind. Monsoon rains cause the ground to be covered with "a layer of mud, water, and feces which of course goes right into the shelters."

Dr. Scrimshaw's observations confirm the estimate that "about one child in five is in a state of critical malnutrition—that means that either death is imminent or the child is suffering permanent, irrepairable damage."

Yet Dr. Scrimshaw's inspection led him to believe that "the Indian government has done a fantastic, magnificent job of coping with the influx . . ." and that the rations given through the International Red Cross are "basically adequate for the situation." (Over five million people receive daily rations containing a little over 2,000 calories and a moderate amount of protein.)

Special Lessons for Children

"But—and this is the lesson for nutritionists—the conventional relief measures which the Red Cross knows how to administer completely overlook the problems of young children.

"The children arrive at the camps exhausted and undernourished. Then, due to poor sanitary conditions, they develop diarrhea. When this occurs, the child is given only tapioca or barley water—often obtained by selling the child's food ration—because the refugee families believe this is the proper treatment for diarrhea. This diet contains almost no protein, so soon the children are suffering from malnutrition."

The result is "an apallingly high incidence" of the protein deficiency diseases marasmus and kwashiorkor.

A particularly tragic complication is that "most of the medical personnel in the camps are unaware of the magnitude of malnutrition among the children." As a result, critically undernourished children usually do not receive proper treatment.

The lessons to be learned extend far beyond India, for "we should also be equally concerned about the damage which children . . . throughout the developing countries of the world are suffering in similar ways."

Furthermore, he said, we must face the lamentable fact that "medical education does not focus on dealing with family nutrition and sanitation—either in India or in the United States. The physicians in the camps try to treat disease, but they do not recognize malnutrition as a disease."

The All India Institute of Medical Sciences has developed a program to improve conditions in the camps, Dr. Scrimshaw reported, but it has been unfortunately delayed by lack of funds. It would (first) provide for all the children in the camps a high-protein, nutrient-enriched beverage, and (second) seek out the malnourished children and see to it that they receive proper nutrition and treatment. (A co-author of the proposal was Dr. B. N. Tandon, former researcher at M.I.T.)

One in five Pakistani refugee children in India is in a state of critical malnutrition, M.I.T.'s Professor Nevin S. Scrimshaw found on a recent inspection. (Photo: N. S. Scrimshaw)

In addition, Dr. Scrimshaw urged that a program be developed to combat communicable disease.

"Cholera is now under control, but it is almost certain to return during the next cholera season; diptheria has been seen in many of the camps; and under the conditions . . . the common communicable diseases of childhood are going to sweep through the camps and kill many children."

Perhaps the grimmest aspect of Dr. Scrimshaw's report is that no end is in sight. Although there are plans to construct slightly better shelters for the refugees, people are still crossing the border at between 20,000 and 40,000 per day—"and for the same reasons they have been coming since March." Officials estimate that there will be 12 million Pakistani refugees in India by the end of 1971.

COMPUTERS AND SYSTEMS

Quiet Flow The Data

International scientific congresses often feature a kind of competition between East and West, as to who is going to form the larger group of participants, and whether the U.S. or the U.S.S.R. will produce more papers, speakers, and new developments. The International Federation for Information Processing's 1971 Congress, held in Ljubljana (Yugoslavia) at the end of August, was different: out of some 3000 participants only 18 came from the Soviet Union, as against 380 from the U.S., 125 from Hungary and some 150 from other eastern countries. Out of 29 "invited papers," 4 had Russian authors, while 13 were presented by U.S. citizens. Similar proportions were to be found among the 218 "submitted papers" of the seven technical sections. On top of that, many of the Russian authors did not turn up at all, so 14 out of their 19 papers had to be withdrawn.

This was by no means due to any discrimination against Soviet authors, for the chairman of the program committee, who had to invite speakers and select from the 588 papers submitted—and did some hard work during three years of preparation—was an outstanding Soviet scientist, Academician V. M. Glushkow. The same applies to Academician A. A. Dorodnicyn, who held the office of I.F.I.P. President for the past three years and only at the end of the congress passed it on to Prof. Heinz Zemanek, a famous Austrian expert on computer science. So speculations ran high amongst the participants as to why the Russians had been so remarkably reserved about their accomplishments, quite contrary to their usual attitude.

Part of the answer may be that data processing in the West has reached a certain level of maturity as regards the routine applications. A world computer congress like I.F.I.P. '71 is therefore dealing mainly with sophisticated software problems or with quite new and elaborate application systems —topics such as "mathematical methods in the study of neural systems," "speech recognition," and "man-machine interaction."

Here the Russians have very little to report, for the "computer gap" is still widening, both in the number of computer installations and in the ways they are used. The Soviets consequently dealt in the main with mathematical problems, where they have very much to say, and with rather theoretical fields of application, where a few good men with one powerful computer can do a great deal of interesting research.

But the general opinion of the "inside" commentators was that big things in the computer field are being prepared by the Comecon countries. They are finally prepared for the full integration of their computer industry, confident that their well-founded theoretical know-how about hardware, logic, mathematics and so on will bear fruit in a widespread but coordinated and unified computer building program. Licences have already been acquired from Western firms, and the division of work between the Comecon countries has been agreed upon, allotting each country a certain sector in which it will handle research, development and manufacture. An overall plan ensures that all computer systems will be fully compatible in relation not only to programs and operating systems, but also to circuitry, storage, peripherals and so forth.

If the Soviets succeed in covering their integrated, centrally planned economy with an integrated, decentralised and fully compatible computer network, using one or only very few languages (as against the continuous competition of new programming languages in the West) they will certainly have a lot more to say when I.F.I.P. meets again in 1974 and in 1977.—*Fred Margulies*

The Systems Zoo

A great many people have spent a great many hours trying to analyze systems. But, said Gerhard L. Hollander of Hollander Associates in opening this fall's Joint National Conference on Major Systems in Anaheim, Calif., the plain fact remains that "most of the important design decisions—the key trade-offs and the allocations of resources—are still made intuitively by knowledgeable managers."

There is still no "science of structuring major systems," he said. Why?

Mr. Hollander, who studied electrical engineering at M.I.T. in 1953, proposed two sets of reasons. One set lists the obvious problems: major systems are large, complex, nonlinear, and dynamic; and criteria—and hard data upon which to evaluate them—are often missing.

The other reason, said Mr. Hollander, is because the scientific zoo is full of systems scientists who ignore the real problems and develop instead "games with which they can cope more successfully." Among its inhabitants he listed:

☐ The problem-seeker, who spends all his time looking for a problem to fit his particular, and perhaps powerful, solution.

☐ The simplifier, who manages to reduce every major system to four significant variables, the limit of his techniques.

☐ The scoffer, who relies simply on "gut" feeling to solve his problem.

☐ The ostrich, who finds several tangential problems that he can solve when he is stymied by the problem to which he was originally assigned.

☐ The data collector, who has reams of data on everything and spends his time and others' money turning up interesting but irrelevant cross-correlations and regressions.

☐ The hypothesizer, who postulates models so complex that no one can disprove him.

☐ The simulator, who obtains his answer on the basis of simplifying assumptions and then, forgetting that he made the assumptions, takes the output of his model as reality.

☐ The technique refiner, who tackles in greatest detail one aspect of a problem, neglecting all others.

☐ The rigor mortician, who rejects every notion that cannot be proved rigorously.

☐ The sage, who knows everything about how to design a major system

but leaves the application of his methods as an exercise for the student.

☐ The savior, who presides over a laboratory and shares his global answer for all major-systems problems only in private communications to his disciples.

Real systems men must be the best of all these at once, said Mr. Hollander. Even so, there remains the probability that systems analysis and operations research will often be inadequate to their tasks (*see below*). Indeed, he said, "the complexity of any major system and the lack of complete data force all to recognize some degree of uncertainty."

Professionalism vs. Super-Computer

Two years ago the Operations Research Society of America was persuaded by Albert Wohlstetter, University Professor in Political Science at the University of Chicago, to empanel six of its members to create a statement of guidelines for the practice of operations research. Two years later the Society has ended up with a set of innocuous principles which—like most of their kind—will remain largely unread. But it is split asunder by a debate—not about the report proper, but about one of its appendices in which the panel charges some non-members of O.R.S.A. with violations of operation research principles, and at the same time lays itself open to similar charges.

The case began in November, 1969, when Dr. Wohlstetter, whose analyses led him to support the Nixon administration's position on A.B.M. deployment earlier that year, asked O.R.S.A. "to consider some aspects of professional conduct" which seemed to him to arise in the Congressional A.B.M. debate. He referred to conflicting testimony by himself and George W. Rathjens, Steven Weinberg, and Jerome B. Wiesner, all of M.I.T., before the Senate Subcommittee on National Security and International Operations.

The Subcommittee itself first called attention to the conflicting data, finding the issue—in Senator Henry M. Jackson's words—"an unusual chance to deepen one's understanding of what defense analysis is like"; the Committee therefore printed a special document to explore the "hidden or unstated assumptions" and the "different modes of analysis" involved.

But Dr. Wohlstetter, claiming that defense programming, planning, and budgeting are indeed areas to which operations research has a professional application, wrote O.R.S.A. that "the conduct of the controversy on the A.B.M. provides many outstanding examples of violation of the professional norms."

Extrapolating from a Narrow View?

The issues which divide Dr. Wohlstetter and his three M.I.T. antagonists (Dr. Rathjens is Professor of Political Science, Dr. Weinberg is Professor of Physics, and Dr. Wiesner, now President, was Provost at the time of the testimony) are highly technical; they involve differing assumptions, some based on classified information and so not available to public evaluation, of the vulnerability of Minuteman missiles and of other similarly technical estimates of defensive and offensive capabilities.

The O.R.S.A. committee's analysis fulfilled Dr. Wohlstetter's expectations. "The evidence strongly supports the disturbing conclusion" that when anti-A.B.M. opinions were supported with arguments "of an operations-research nature, these analyses were often inappropriate, misleading, or factually in error," the panel wrote in the controversial appendix to the professional standards report. "Moreover, in many instances, elementary standards for proper presentation of results to permit verification and meaningful dialogue were not met," the panel charged.

Much of the criticism by both Dr. Wohlstetter and the O.R.S.A. panel has its basis in the unwillingness of the A.B.M. opponents to accept the Nixon Administration's assumptions regarding Soviet technical capabilities (or the likelihood that the full 12-site Safeguard program would ever be procured). The opponents, on the other hand, argued even before the O.R.S.A. study began that any reasonable inquiry into the A.B.M. debate should "question whether or not administration statements, regarding the threat to our total retaliatory capability and Safeguard's effectiveness in countering any such threat, were misleading to the Congress and the public." The M.I.T. group now defend their analyses, arguing that present estimates show that their assumptions of Soviet capabilities and present U.S. plans were more realistic than those they were criticized for not accepting. Moreover, say the M.I.T. scientists, the issues discussed in the O.R.S.A. inquiry represent only a small aspect of the large technological and political arguments which were brought to bear in the course of expert testimony on the A.B.M. in 1969, and that, therefore, the O.R.S.A. panel "has no basis for its sweeping judgment about the overall merits of the analysis."

Five of the 13 members of the Council of O.R.S.A. filed a minority statement proposing that the Society "should not take on the quasi-judicial function of investigating and reporting on professional behavior of individuals." But the majority approved both the panel's proposed professional guidelines and its analysis of the A.B.M. debate as an example, and the complete report was published as the September issue of *Operations Research.*

What Arena for Operations Research?

Is the A.B.M. debate a good basis (if any is needed or appropriate) from which to develop a statement of professional ethics for operations research?

Almost surely not, in the view of Professors Rathjens, Wiesner, and Weinberg, none of whom considers himself an operations researcher or is a member of O.R.S.A. The whole issue is too deeply involved in classified information which cannot be widely shared. Even if the unknowable technical aspects of the debate could be resolved into quantitative terms on the interpretation of which everyone could agree, the political aspects are vital—and irresolvable in such terms.

No one argues with O.R.S.A.'s definition that operations research "is an experimental and applied science devoted to observing, understanding, and predicting the behavior of purposeful man-machine systems." But issues other than system performance have to enter into decision-making; there are some decisions that cannot be reached by reducing all the parameters to quantitative terms. This is what most distressed Philip M. Morse, Professor of Physics, Emeritus, at M.I.T., who founded O.R.S.A. in 1952. He wrote to the *Boston Globe* that "by seeming to argue that there never can be honest differences of opinion regarding assumptions between scientists regarding questions of general policy, (the report) comes down on the side of those who advocate letting a super-computer make all our policy decisions."

Must Power Be Danger?

Robert M. Fano, Associate Head for Computer Science and Engineering of the M.I.T. Department of Electrical Engineering, made two propositions upon opening a seminar on computers and their effects on society at M.I.T. this fall:

☐ As population increases and technology renders life increasingly complex, demands will become greater than any individual alone can fulfill. Only with the power of computers will men be able to manage their society and environment.

☐ Whenever any computer is used, a social decision is made. But what sort of decision will it be? How does the computer itself define the range of decisions which we can make?

Though the forecasts these propositions imply are foreboding, the prospects are not all gloomy; we are better

off than we used to be. The original universal data bank—the universal compendium of information about people and their transactions—was the village gossip. Though we are repulsed by the concept of a national data bank (probably not achievable anyway), no one can doubt that today we want better and more reliable information than came from the village gossip, and a better computer to access it, said William A. Martin, Assistant Professor in M.I.T.'s Sloan School of Management.

Yes, but everyone in the village had a pretty good model of the village gossip, replied Professor Joseph Weizenbaum, Professor of Computer Science, acting as the devil's advocate for the seminar. Everyone knew how to use—and not to use—what the gossip said.

The moral of the story is that the more people use computers the more they need to understand computers' strengths and limitations, said Professor Martin. Given some kind of "computer literacy" among people, no computer can be the ruler of those it is designed to serve.

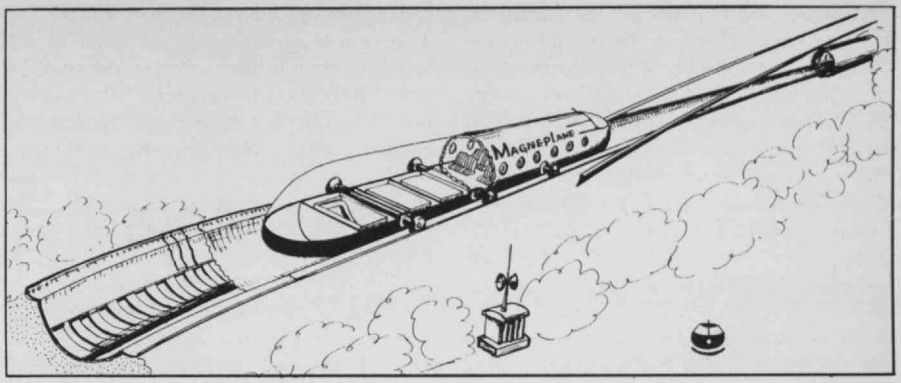
Is this kind of safeguard possible? Perhaps not, admitted Professor Weizenbaum: no one person today—even though he has contributed to building a section of it—can understand all of the immense computer program system called Multics; this system does in fact threaten to become encrusted and tyrannical. But complex systems such as Multics immensely increase our capacity to deal with data; so they give us better control over our alternatives—and more freedom, not less.

He's right, said Jerome H. Saltzer, Associate Professor of Electrical Engineering. Though size is no assurance of accessibility, "the largest computer system in the world is today also the one most accessible—and probably most useful—to most people," he said. What system is that? The dial telephone.

TRANSPORTATION

Flying Low

The ground transportation now in use or in view has limitations that prevent it either from going fast enough to compete with airplanes, or from going at all, Henry Kolm of the National Magnet Laboratory told a seminar at M.I.T. last fall. Any wheeled vehicle (a train, for example) is limited by friction and by bumps in the roadbed. The tracked air cushion vehicle (*see* Technology Review *for October/November, p. 68*) that the Department of Transportation has chosen as the promising alternative is inherently incompatible with the linear induction motor chosen to power it, Dr. Kolm said, because the former cannot provide the smoothness of motion and precise distance from the guideway that the latter requires.



The magneplane, a magnetically lifted and propelled vehicle offered by two researchers at the National Magnet Laboratory, rides on the ground in a trough-shaped guideway. Its proposers feel it has the advantages of an airplane without the disadvantages of being 30,000 feet off the ground. The guideway in front of the vehicle is cut open to show the magnetic coil laminated inside it. The vehicle carries superconducting magnets, whose field remains steady and is acted upon by the moving wave-like field generated by the buried track coils. The wheels are used only when not "in flight."

An alternative that he and Dr. Richard Thornton, also of the Laboratory, think will avoid such problems is a vehicle that is both magnetically lifted off its track and magnetically propelled. The "magneplane" looks like a 707 without the wings and tail. It rides in—and about a foot above—a trough curved to fit its bottom. The same force that lifts the vehicle propels it: a moving magnetic field, generated by aluminum coils laminated into the fiberglass and aluminum track, interacting with fixed superconducting coils on the vehicle. The car itself is passive, in the sense that its superconducting magnets consume no power *en route* and do not change polarity.

The active guideway is divided into sections, from one to ten miles long, each with its own wayside power substation. Each substation responds to the approach of a car by supplying alternating current to its section of track, at a frequency that moves the magnetic field at the desired speed. The alternating poles draw the vehicle's magnets along the guideway. After the car leaves the section, the current is switched off.

The guideway surrounds one-third of the vehicle's circumference. Only its bottom contains active conductors; the sides are continuous sheets of aluminum, which is a good enough electrical conductor to effectively prevent the magnetic field from entering it at the vehicle's cruising speed (anything between 20 m.p.h. and 320 m.p.h.). The result is a magnetic pressure that supports the car. Ten Mw. of power are converted to a ten kG field, for a lift of 60 psi, adequate for the 40-meter, 200-passenger vehicle.

The guideway need not be as smooth as a linear induction motor requires—variations of two inches or so are permissible. Indeed, Dr. Kolm claims his system as the first high speed ground transport proposal "which permits an economically constructed active guideway having reasonable dimensional tolerances. The trough . . . can be laid directly on a bed of sand." Because the vehicle is cylindrical, it can tilt itself at curves, obviating the need for an accurately banked guideway (which has the drawback, anyway, of being specific for a single speed). Dr. Kolm insists that magnetic levitation and propulsion—whatever their reputation—are more practical than the advanced high-speed ground transport systems now in favor.

ECONOMICS

Out of the Bretton Woods

The opportunity to build a new monetary system comes at most only a few times a century, said James Tobin, Sterling Professor of Economics at Yale. We should use this one carefully. He was speaking of currencies, at a four-man seminar of economists held at M.I.T. in the fall.

Some new ways of relating currencies have been suggested, he added (see following story), and letting exchange rates float while seeking the best replacement for the Bretton Woods agreement would carry no danger. (A treaty drawn up at Bretton Woods, New Hampshire, in 1944, set the post-war monetary system. It defined the dollar in terms of gold, and tied the yen, mark, frank, lira, pound, etc., to the dollar at official rates declared by their governments.

Milton Friedman had it right ten years ago, said Paul Samuelson, Institute Professor of Economics, when he argued for more flexibility. Since 1964 or 1965

especially, the dollar has become greatly overvalued. Other countries have not revalued upwards because that maneuver is politically very difficult. (It antagonizes the revaluer's own exporters, for example.) A spirit has reigned, he said, of benign neglect. (Is the opposite, he asked, malignant preoccupation?)

Dr. Samuelson would remove gold ("a barbaric instrument") from a direct relation to money. He would buy newly mined gold from South Africa at $35 an ounce, a price set in perpetuity, and relate the values of currencies to "paper gold" (formally called Special Drawing Rights); these values might shift a bit to permit adjustments between nations—when they are necessary, not afterwards.

Several speakers worried about a rise in protectionism they saw in the United States, expressed in a particularly aggressive way by the import surcharge. The surcharge, they felt, looks to the rest of the world suspiciously like a weapon. It violates the General Agreement on Trade and Tarriffs (G.A.T.T.), said Dr. Franco Modigliani, Institute Professor of Management at M.I.T. He added that by making the dollar inconvertible to gold, as he did on Aug. 15, President Nixon also violated the agreements supporting the International Monetary Fund. (G.A.T.T. was arduously arrived at over many years of delicate negotiations, another M.I.T. economist told TR. He felt the whole structure to be jeopardized by the surcharge—our position as a leader in reducing tariffs was now lost, and other countries could freely raise their import duties as we had raised ours.)

Once the dollar was floating, Dr. Modigliani added, the reasons for accumulating dollars—to take advantage of favorable exchange rates—were gone and there was therefore no reason to address that imbalance with a surcharge on imported goods. It is an artifact that actually hinders the process the float was designed to allow, whereby currencies can find their natural levels.

A fourth participant, Guido Carli, a Governor of the Central Bank of Italy, limited his public comments to a critique of Dr. Modigliani's proposal for a new monetary system (*see following story*). But his comments naturally bore on President Nixon's action of August 15 and indicated the delicacy of the planning required if the system to be adopted is to be equitable for all nations and flexible for easy financial maneuvers. For example, he said that balance of payments constraints, whatever they are, should operate in all countries for both a surplus and a deficit. (Today, what constraints there are basically concern deficits, like the one the United States presently has. But countries must also seek a balance when they have a surplus.) He felt this to be a valuable part of Dr. Modigliani's reforms. Whether or not the expectation was politically realistic, he was not sure.

A More American Dollar

Everybody has a plan, remarked Dr. James Tobin to the economics seminar (*see above*), for new financial relations, including Dr. Modigliani. Dr. Franco Modigliani, with Dr. Hossein Askari of Tufts, offered in Princeton University's *Essays in International Finance* a "Reform of the International Payments System." The plan was devised to modify the Bretton Woods agreement, before President Nixon suspended it, but Dr. Modigliani feels the proposal is itself a workable system. The Bretton Woods treaty, in response to post-war conditions, built an assymmetric system that gave advantages in the handling of money to countries badly in need of financial development and that rested on the dollar for stability. The dollar was yoked to gold; its equivalency in gold could not be changed if the United States wished. The yen, mark, franc, lira, etc, were free to be changed, however, with respect to the dollar and to gold and paper gold, according to the needs of the countries they served.

The Bretton Woods system had three shortcomings that urgently required change, Drs. Modigliani and Askari wrote.

☐ Exchange rates, once set, were quite inflexible—only narrow fluctuations were permitted. Rates could not adapt easily to changing economic conditions.

☐ By agreement (*de jure*), the dollar could be exchanged for gold or Special Drawing Rights (S.D.R.'s) on the demand of the government holding them; in fact, however, we could no longer honor that agreement. We could not adjust our rates of exchange to other currencies, although other governments could adjust theirs to each other and to the dollar. Because we could make no adjustment, our deficit abroad had grown far beyond our holdings in gold and S.D.R.'s with which to redeem it.

☐ The fixed parity of the dollar to gold and S.D.R.'s meant that the behavior of American prices controlled the purchasing power of the international reserves of other countries and made our domestic price policy a matter of international concern.

Drs. Modigliani and Askari suggested five reforms:

☐ The band of fluctuations now permitted around a rate of exchange is 2 per cent; it would rise to at least 4 per cent.

☐ The parity of any currency with the dollar would be set on any given day by taking an average of the market rates over a stated period. Parities could inch up and down, but only slowly.

☐ The dollar would be permitted to move in relation to the paper gold (S.D.R.'s)—which would replace gold as the ultimate definition of value—according to the behavior of a dollar price index of internationally traded commodities. The dollar would thus be separated by one step from paper gold.

☐ The dollar would become inconvertible *de jure*—as it indeed became on August 15. It need no longer be converted to gold or paper gold on demand of a foreign official. Foreign powers could ask to have their reserves of dollars expressed in Special Drawing Rights on the U.S. Treasury: the reserves would earn interest equal to that paid by the International Monetary Fund on paper gold balances, and would be protected against the risk of changes in the parity of the dollar to paper gold. Such claims however, could only be paid in dollars, according to the parity at the time of redemption.

☐ The United States would undertake to reduce its deficit when it was judged excessive and to increase it when judged insufficient—those conditions being determined by stated criteria involving exchange rates of the dollar with other currencies and the reserves of dollars held by other countries.

Freedom and Stability

The system is still asymmetric, Dr. Modigliani told the *Review*. But he sees a value in retaining the asymmetry, even if the dollar was not the specially treated currency. The asymmetry gives an advantage to countries to whom foreign trade is a much larger part of the economy than it is to the United States—our foreign trade is only about 15 per cent of our total. It is easier for other countries to handle their supplies of money internationally than it is for us, but he feels we can afford them that freedom. The dollar is freed, too, to float under carefully managed conditions that would preclude speculative profiteering. Control would be in the hands of foreign central banks, but the United States need not convert to gold, so the desirability of amassing dollars would be gone.

The dollar would still be a reserve asset, but a more useful one because the uncertainty about the value of dollar reserve would be eliminated. The value of these reserves would no longer depend on an uncertain right to conversion into gold but would be instead based on their power to acquire American goods and on their acceptability by other countries in settlement of international obligations.

Five Problems and Some Annoyances

In a time of "broad public concern about science and its applications" and about the support of higher education generally, five issues "where we are seeking still to understand the problem and to find a clear pattern" now plague U.S. institutes of technology, according to Howard W. Johnson, Chairman of the M.I.T. Corporation. The five, as listed by Mr. Johnson in his last annual report as President of the Institute (for 1970-71) to the M.I.T. Corporation:

☐ The need to better develop the full power of the humanities for a technical curriculum. "We know that the study of humanities must be interlocked with the study of science, that there is a unity of liberal education," Mr. Johnson told the Corporation. Though some students achieve this "oneness of education, we are troubled by the apparent inadequacy of our educational structure to ensure that this integration is fully effective. . . . It is a problem of immense significance," Mr. Johnson said.

☐ What can be the role of a university in public service? Though M.I.T. is proud of its record in the past, Mr. Johnson said, "the paths are more complex in these times, and the integration of service with education poses some quandaries whose resolution is not yet clear." New definitions of the interface between service and education remain to be found.

☐ "There is a pressing demand for patterns of education for adult life—for alumni, for example, and for mature professionals in many fields," Mr. Johnson said. Though M.I.T. has a number of programs for such groups, "surely new technology can produce imaginative ways to satisfy the need to learn anew, and we must find them."

☐ The "specter of underutilization and unemployment"—particularly in the case of graduate-degree recipients and in the physical sciences and engineering—is a major and wholly new problem. "I do not agree with the grim predictions of those who see major unemployment in the last half of the decade," Mr Johnson wrote. But "boom or bust is no basis for effectually providing for the scientific development of the nation," he said.

☐ "The financial problems ahead for higher education are horrendous." Increasing tuition must continue, though it is a trend which "could eventually exclude many of our students who fall in the financial range between the very needy and the very affluent from attending M.I.T.," Mr. Johnson wrote.

But despite these problems President Johnson called 1970-71 "a good year for M.I.T." And though he is aware that "the prevailing atmosphere for higher education tends to be gloomy," Mr. Johnson wrote, "I do not share it." There have been important new developments in teaching, "the effective beginnings of several new laboratory efforts," and the start of several new physical facilities; and M.I.T. has "largely held its own" in the continuing struggle to maintain financial support. Indeed, wrote Mr. Johnson, "the Institute finished the year on a break-even basis, once again without incursion on endowment funds."

Interdepartmental and departmental sponsored research increased from $46.4 million to $49 million, but inflation was great enough to mean that these figures represent little if any real growth. Meanwhile, research in the Lincoln and Draper Laboratories—and certain special departmental projects—decreased from $99.1 million to $87.2 million. Meanwhile, a "steady erosion" in the number of federally funded graduate fellowships presents the Institute with "a serious crisis in the support of able, young people who wish to pursue science and engineering at the graduate level."

Beliefs	Humanities	Social science	Natural science	Biological science	All fields
Astrology	4.14	3.84	5.25	3.90	4.16
ESP	13.00	11.44	13.75	12.16	12.24
UFOs	5.88	7.00	5.25	8.30	7.14
Prayer	5.20	8.50	5.00	8.20	7.68
Witchcraft	2.94	4.34	5.25	3.54	4.12
Evil force	3.06	2.22	4.75	4.44	3.40
Supreme being	10.40	12.70	12.00	12.16	12.04
Personal god	7.20	9.54	13.00	8.14	9.56
Mean	6.48	7.45	8.03	7.61	7.54
No. of subjects	15	37	8	37	98

The beliefs of graduate students, on a scale in which 0 represents "total unqualified disbelief" and 20 "total unqualified belief." (See "Epicurean Doctrine Refuted")

Epicurean Doctrine Refuted

It has been suggested from time to time that a scientific education enables people to be more rational and less superstitious. This perpetually modern idea was powerfully asserted in the epic-length science-poem *De Rerum Natura* by Lucretius (95-55 B.C.), who cited as his authority the Greek sceptic Epicurus. In our own day the hypothesis that science is inimical to supernatural beliefs is being scientifically tested, and is proving to be itself a superstition.

In 1968 Gustave Jahoda, of the University of Strathclyde, published a letter in *Nature* (*Vol. 220, p. 1356*) showing, among other things, that at the University of Ghana students did not weaken in their "magico-mythical world view" as they progressed through a science degree course (*see "Trend of Affairs" for April, 1969, p. 82*). Similar work was later done at Harvard, with the same results. Charles A. Salter and Lewis M. Routledge have now extended the research to post-graduates and to women students, at the University of Pennsylvania (*Nature, Vol. 232, pp. 278-279*).

They studied 98 graduate students (and spouses of graduate students) in relation to their beliefs in astrology, extra-sensory perception, flying saucers, prayer, witchcraft, "an evil supernatural force," a supreme being, and a personal god. (Adherents of the Epicurean doctrine generally lump superstition and religion together indiscriminately.) Their figures for graduate studies in general—including humanities as well as the sciences—appear at first sight to show a slight trend toward scepticism during the successive years of postgraduate study, but the trend is so slight as to be statistically nonsignificant.

As regards the differences between science students and others (*see table*) the new work conflicts slightly with the earlier research, in that the most irrational students were the physical scientists, and the least so the humanities people. But again the differences were too small to constitute a statistically significant finding. Neither was there any significant difference between the sexes.

The authors conclude that their work, and that of their predecessors, "indicates that university education in all fields has little effect on the supernatural beliefs held by male and female graduate students," and that "the striking similarity of the overall results in three different populations indicates a real phenomenon for further study."

A Watery Ore

The main technical problem in mining the metal-rich central deeps of the Red Sea may be not so much getting the minerals out of the Red Sea as getting the Red Sea out of the minerals, M.I.T.'s Joseph B. Lassiter III told the American Chemical Society at its September annual meeting in Washington.

The top 10 meters of precipitates under the 2000-meter-deep hot brine pools of the Red Sea are estimated to contain up to $2.5 billion worth of minerals—iron, zinc, copper, silver, gold, and lead. If, as is suspected, the layers are much thicker in some areas, then the value may be much more.

The precipitates are fluid enough to be pumped up, rather than mined. This is both an advantage and a disadvantage: a "slurry" is easy to handle, but in this case the hot brine in which the ore is slurried is extremely corrosive—even to stainless steel. (The brines are about ten times saltier than normal sea water—but with a disproportionately higher metal content—and they are at temperatures between 36° and 56°C.)

Nevertheless, Mr. Lassiter, who is an Instructor in M.I.T.'s Department of Ocean Engineering, feels that the corrosive slurry can be handled and transported to the nearest port (by barge, from a floating dredge) for a dockside selling price of about $3.40 per ton of ore. In the form in which it arrives at dockside, the slurry would contain ore worth about $15 per ton, "which is not the world's best ore," Mr. Lassiter noted.

"But if that same ore were dry and brine-free," he went on, "it would be worth around $30 per ton—which is very good ore." Unfortunately, the arid lands around the Red Sea cannot afford a supply of fresh water to wash the ore, and there is as yet no technology for directly processing ore mixed in brine.

"We're in a bind," Mr. Lassiter told the assembled chemists, "and hopefully we can interest some chemists and metallurgists in working in this area." The processing of the Red Sea's ores is a neglected field, Mr. Lassiter feels, because the people who control the purse-strings generate more profit by extending existing technology to exploit lower-grade land ore deposits than by gambling on the developments of new technology to exploit submarine ones. If ocean resources are to be developed, process chemists and metallurgists must define the costs of dressing and refining.

If it becomes technically feasible to exploit the Red Sea ores, and if it is shown to be economically worth-while, only one obstacle—the political one—will remain. (*See "Minerals and the Law of the Sea" by Lucy Sloan in* Technology Review *for October/November 1971.*) International agreements place the part of the sea containing the ores in Sudan's domain, yet Saudi Arabia claims the entire Red Sea. Ethiopia claims the largest of the brine pools (but not the other two), and quite recently, Miss Sloan reports, a Liechtenstein law firm claimed the rights to the deposits on behalf of an unidentified client. Unfortunately, these manifold disagreements will have to be resolved in a part of the world which is not characterized by effective diplomacy.

Underwater Underemployment

"Today, the future of the submarine belongs as much to industry as to science. For both, this working tool soon will be used like the automobile, the railway train, the plane, the motorcycle, the bulldozer, the truck, or even the crane—wherever there is a need to travel or move something underwater." Thus wrote Dr. Jacques Piccard very recently. And indeed, a variety of vessels exist which are more or less adapted for labor or research at depths of a few thousand feet: *Deepstar, Deepquest, Trieste* (I and II), and the 50-foot-long *Aluminaut,* for example.

But where are these dramatic dirigibles of the deep? Mostly in mothballs, it emerged at a symposium on "working in the ocean" sponsored by M.I.T.'s Sea Grant Program. Why? Mainly for lack of work that justifies the cost of operation.

This is not true of the smaller submersibles. The newly refurbished *Alvin,* for example, has a long waiting list of tasks. But submersibles as a class suffer from the ills of a half-developed technology, and the bigger the vessel the bigger the troubles. Mr. Roswell F. Busby, supervisory oceanographer in the Naval Oceanographic Office, outlined some of the troubles, after giving due credit to such achievements as *Alvin*'s recovery of a dropped H-bomb and *Aluminaut's* recovery of *Alvin.*

In general, submersibles can be operated for perhaps 50 per cent of any pre-arranged period. It is usually claimed that launching is possible in seas of state 4 (i.e. wave-heights of 5-6 ft., winds 14-18 kt.) but in practice this is not easy because of motion difficulties. And, once submerged, a submersible does not always move in the dignified manner that the publicity leads one to imagine; Mr. Busby had his audience laughing merrily at some of the trajectories he had witnessed.

Endurance is limited to 24 hours, by the power system, but often the user cannot stand the cold for more than half this time. Then there are the problems of designed-in incompatibility with the human frame. Mr. Busby showed one manufacturer's drawing in which two undersea explorers appeared quite comfortable in their spherical shell, until measurement and calculation revealed them to be pygmies. Some submersibles incorporates elementary mistakes such as viewports from which the external tools are invisible at critical phases of their use. Then there is electrical interference between exploration instruments. In sum, much de-bugging remains to be done, at a rather basic level.

The only cost-effective tasks for today's submersibles, said James W. Mavor of Woods Hole Oceanographic Institution, are in salvage (leaving aside pure research, presumably). Mr. Busby added that the use of these vessel is increasing nevertheless. "Perhaps we just went too deep, too fast", he suggested.

Mr. Willard F. Searle, a visiting lecturer in ocean engineering at M.I.T. and an eminent consultant in the field, spoke vigorously in opposition to the notion that undersea engineering was an "adventure." He had encountered much talk of "adventure" in the publicity of one major aerospace company entering the business, and thought that perhaps it accounted for the company's "pie-in-the-sky cities-under-the-sea" ideas—and their prices.

Working in the sea is just that, said Mr. Searle, and to succeed one must do three things about the sea:

☐ Contend with it—for instance, keep it out of the equipment.

☐ Cooperate with it—plan for times when currents are minimal; find ways of using buoyancy and wave-motion.

☐ Avoid it—avoid, particularly, the surface; and minimise the amount of work that has to be done by divers.

Nature's Way With Oil Spills

One way of removing oil spilt at sea, according to two Rutgers microbiologists, would be to add nitrogenous and phosphate fertilizer. The suggestion is based on laboratory experiments with crude oil, simulated seawater, and bacteria obtained from actual seawater. It was put forward by R. Atlas at a session of the American Chemical Society's division of Microbial Chemistry and Technology, during the Society's annual meeting in September.

The seepage of petroleum into the sea, and its disposal by bacteria, are natural processes. At Rutgers, Atlas and R. Bartha first studied the biodegrada-

tion of Sweden crude oil when agitated together with artificial seawater containing marine bacteria (of one or other of two types, "tentatively identified as a *Flavobacterium* species and a *Brevibacterium* species"). They found that degradation seemed to begin in earnest after a lag of two to four days. At about 15 days, about 60 per cent of the oil had been converted to some other chemical form, and 30 per cent had been completely mineralized—that is, reduced to inorganics. At this point the process levelled off.

The researchers then set out to check their theory that the reason petroleum biodegrades so slowly in the sea is not for lack of bacteria, but for lack of nutrients (for these bacteria live not by petroleum alone). They added oil to four liquids: ordinary seawater; the same with either a nitrate or a phosphate added; and with both nutrients. The first three behaved very much like water that had been sterilized; the last, in 18 days, gave 70 per cent biodegradation—indicating that suitable organisms were indeed present.

Some of the audience were clearly disturbed at the idea of putting this finding to practical application, feeling that to cover spilt oil with fertilizer would add environmental insult to injury. But Atlas thought it should be possible to avoid stimulating any unwanted biological reactions, by combining the fertilizer with a hydrophobic substance, thus adding it to the oil but not to the surrounding sea. In reply to another question, he said that the seawater used in the experiments had been from near the coast, and that each environment would need to be studied separately to establish a suitable treatment.

The paper by Atlas and Bartha was one of many on the theme of the biological treatment of waste petroleum. Other researchers had worked also with fungi. A team from Georgia and Louisiana State Universities had extracted yeasts from heavily oil-polluted waters (reasoning that this was a likely place to look for organisms specializing in oil), and added mixtures of them to various types of oil, left to stand in buckets, outdoors, for three months. They observed between 20 and 60 per cent degradation.

In the future, said Georgia State's Warren L. Cook, the team will try mixtures of yeasts and bacteria. Cook clearly believed that the road to successful biodegradation lay in finding the right combination of organisms and adding them to the oil, rather than providing extra nutrients and letting the organisms look after themselves.

A number of researchers are studying the possibility that the rate at which an oil is consumed by micro-organisms is in practice limited by the surface area which it offers. At the University of Western Ontario, B. Supplisson and J. E. Zajic have been selecting organisms specifically for their ability to reduce Bunker C fuel oil to an emulsion (rather than actually to degrade it). And at M.I.T.'s Department of Nutrition and Food Science, reported D. I. C. Wang, experiments have been performed to establish the precise relationship between rate of biodegradation and "specific area" (i.e., surface area of oil droplets per unit volume of the mixture). Using a single paraffin—n-hexadecane—and a single yeast, *Candida intermedia* (which has been used at M.I.T. for some years and is "quite well adapted to *n*-paraffins"), Wang and A. Ochao made absolute measurements of specific area during the growth of the yeast in an agitated mixture of paraffin and aqueous growth medium. It turned out that the rate of growth of the yeast was indeed proportional to the surface area of oil available to it.

RATES OF CHANGE

Century of Progress

If it took 240 workers three years to build the Eiffel Tower, how long does it take 21 workers to build a one-third scale replica?

Wrong. The productivity of the Eiffel-Tower-building industry has apparently increased by a factor of five in the last 85 years, for according to *Engineering News Record* (July 8, 1971, p. 13) it took three months. According to the *Technology Review* slide-rule, these figures imply an annual increase in productivity of about 1.9 per cent.

The generality of this result is reinforced by the circumstance that the architect of the replica was Swiss, the steel fabricator Austrian, and the general contractor, structural engineer, and steel erector were all from Cincinnati. Any lack of complete seriousness can be attributed to the fact that the new Eiffel Tower "is the centerpiece of a $25 million, 1,600-acre amusement park in Kings Mill, Ohio."

Instant Science

On 11 and 12 January, 1970, about 150 whales swam aground on a two-mile stretch of beach at Fort Pierce, Fla. Towed out to sea, the whales immediately swam back and grounded themselves again.

Not Ripley's *Believe It Or Not*, but the annual report of the Smithsonian Institution's Center for Short-Lived Phenomena. The Center, set up in Cambridge in 1968, is dedicated to the observation of events which might otherwise be over and done before a competent observer reached the spot.

Pseudorca Erasciden, *the False Killer Whale, pulled a switch on the lemmings last year when about 150 apparently healthy mammals beached themselves on the Florida shore to die. On-the-spot examination revealed no cause for the phenomenon. (Photo: Wometco Miami Seaquarium)*

It has over 3,000 correspondents in about 150 countries, and with the help of the Smithsonian Observatory's worldwide communication links it can contact "virtually any point on earth" in a matter of hours. It has received an overwhelming welcome from scientists everywhere.

The 113 short-lived phenomena reported in 1970 included 49 earth-science events (mostly volcanic eruptions and earthquakes), 47 in the life sciences (including 16 oil spills), and 15 astrophysical events. The latter were mostly meteorites and fireballs, but seismic activity on the moon is tucked away in the middle of this section of the report. So is the extremely short-lived and quite mysterious Naini Tal Sudden Sky Brightening, which lasted about one second and was reported by two astronomers at Uttar Pradesh State Observatory, in the foothills of the Himalayas.

There is one more section: urgent anthropology. The year's single event in this category was the discovery of a group of "stone-age" nomadic Indians in Paraguay, who have previously had almost no contact with Europeans. They belong to a people called the Guajaki, and are among the last of them still in their native state. The group is rated as a possible short-lived phenomenon due to the expansion of logging and farming in the area. The report also contains a follow-on to last year's account of another nomadic stone-axe-using tribe, in Surinam. Just how evanescent an anthropological situation can be is illustrated by the fact that these people, between their second and third meetings with missionaries (September 1968 and February 1969), split up into (literally) two camps—a small one in favor of the mis-

sionaries and a larger one against them. Since that time the tribe has been visited by no anthropological observers, but by many well-wishers with steel implements, agricultural demonstrations, and Bibles, intent on converting them from nomads into villagers.

Among other threatened species is a bovine, the Cambodian Kouprey, apparently "the nearest thing to a relic of the possible missing ancestors of the Indian Hump cattle, which makes it especially important for genetic studies." In spite of Cambodian and U.S. attempts to preserve the Kouprey, it is on the edge of extinction. It appears that the areas inhabited by the animal are now down from three to one, a northern region bordering on Laos, "overrun with Vietcong." The Cong have a great fondness for beef.

In contrast, there are creatures whose populations occasionally grow out of all proportion. The scientific interest of such events is obvious: one would like to be able to trace the origins of instability in particular ecological systems. The most famous outbreak listed in the report is the "crown of thorns" starfish plague, which was drawn to the attention of the Center in May 1969. The Center in fact played a major role in stimulating investigation of the coral-destroying irruption. What caused it? Australia's Dr. Robert Endean, an authority on the starfish, suggested that the starfish's predator, the giant triton, has been critically diminished by shell-collectors. A U.S. study agrees, but also blames other activities—blasting, dredging, and chemical pollution. Navy divers have been deployed against the starfish, killing them one by one with injections of ammonium hydroxide.

The report also tells of other plagues: of mice in Australia; of blackbirds in North Carolina; of caterpillars in New England; of snails in Arizona (predicted by Dr. Albert Mead, who now warns against even worse pestilence of giant African ones) and of white-tailed dormice on a Mediterranean island near Spain.

Interleaved among these biological excursions are the 1970 oil spills, some of which received little publicity. In February and March of that year, according to the Federal Water Quality Administration, at least 1000 miles of Alaska coastline were polluted by oil, killing perhaps 100,000 seabirds. The most probable source was deliberate discharges of tank ship "slop oil" and oily ballast. One result was an F.W.Q.A. recommendation that international action be initiated to prohibit the discharge of oil anywhere at sea.

Another Alaskan oil spill, in April, coincided with the death of about 85,000 seabirds, but careful study leads to the conclusion that a coincidence is all it was, this time. (The report contains many accounts of sudden local mortalities of various species, apparently in the normal course of natural events.) One really large oil spill that was successfully cleaned up, and left "no indication of damage to wildlife," occurred in ice-covered water near the Swedish coast, north of Stockholm, when the Dutch tanker *Othello* collided with another tanker and released 60-100,000 metric tons of oil. The oil was burned off, using a technique provided by the Cabot Corporation, of Boston.

But perhaps the perfect short-lived-phenomenon story is the draining of a superglacial lake, Lake Linda in Alaska. This kind of event is of interest to glaciologists and to people who live below. Robert A. Asher, of Michigan State University, was there to watch the 125-metre-long lake run dry, between 13 and 15 August. "Previously," writes Mr. Asher, "it was thought that this type of lake disappeared in a flash and in the middle of the night."

NUCLEAR

Infernal Machine

The search for constructive uses for large explosions has turned up yet another possibility: the creation of new geothermal power facilities, where the natural heat in deep rocks is presently inaccessible. Present geothermal power schemes depend upon the existence of underground water in intimate contact with such rocks, producing steam or hot water which can be tapped (*see October/November issue pp. 42-48*).

The American Oil Shale Company and the Atomic Energy Commission have prepared *A Feasibility Study of a Plowshare Geothermal Power Plant,* now obtainable from the A.E.C.'s Division of Peaceful Nuclear Explosives, which concludes that artificially stimulated geothermal power "may prove to be competitive, 5 to 7 mill/kwh, under certain conditions." It envisages a 200-Mw. power station with a 30-year lifetime, running on steam obtained by injecting water into naturally hot rocks which have been fractured by nuclear blasts.

The simplest method is to fire an array of bombs in the rock, so that the resulting fractures connect together, and then build the station, which will hopefully be able to draw heat from the rock throughout its lifetime. Alternatively, the station could be "hardened," and explosions could be set off beneath it every ten years. A third alternative is to mount the station on a barge and tow it to a safe distance whenever the heat source needs another loosening-up. This seems to be the cheapest way.

"The hot rock is expected to be deep enough so that even very large explosions can be contained, and the closed design of the system will guard against the release of radioactivity," says the report.

Socio-Nuclear Engineering

Conflict between electric power developers, particularly nuclear, and active segments of the public is now a research topic in its own right. The annual meeting of the American Nuclear Society in Boston this summer featured a study of "public attitudes toward nuclear power and electric utilities," by a team from Consolidated Edison of New York, Purdue University's department of nuclear engineering, and the same university's educational psychology section: respectively, G. T. Seeley, P. J. Fulford and D. J. Treffinger.

The researchers studied two groups of people, one consisting of known critics of nuclear power developments, and the other drawn at random from telephone directories. By interviews, they investigated the subjects' opinions on, and knowledge of, nuclear power, and their attitudes toward a wide variety of sources of information.

The great majority of the "critics," as well as of the "public" group, believed that at least some power plants should be nuclear, rather than coal, oil, or gas. The difference between the two groups was that the critics tended to see the choice in terms of safety and environmental questions, whereas the general public saw it rather as a matter of environmental questions and economics. The two groups had about the same average level of technical understanding, although the critics were more varied in this respect, "indicating that audiences composed mainly of critics will likely include some very knowledgeable people."

The main output of the study was a set of recommendations as to how power utilities could "improve their communications with the public regarding nuclear power." The recommendations include:

☐ "Strive for good communicator credibility in each situation by: (a) using knowledgeable, well-prepared speakers; (b) establishing audience rapport, if possible; (c) avoiding anything which could indicate to the audience that the utility wants to change their attitudes."

☐ "Advocate as large a discrepancy as possible between the utility position and the audience's attitudes" (because "this places a larger pressure on the receiver to change his position than would be the case if a position had been espoused which was only slightly

different from his").

☐ "Approach critics and the general public differently, by: (a) refuting opposing arguments and drawing conclusions implicitly when speaking mainly to critics; (b) ignoring opposing arguments and drawing conclusions explicitly when speaking to the general public."

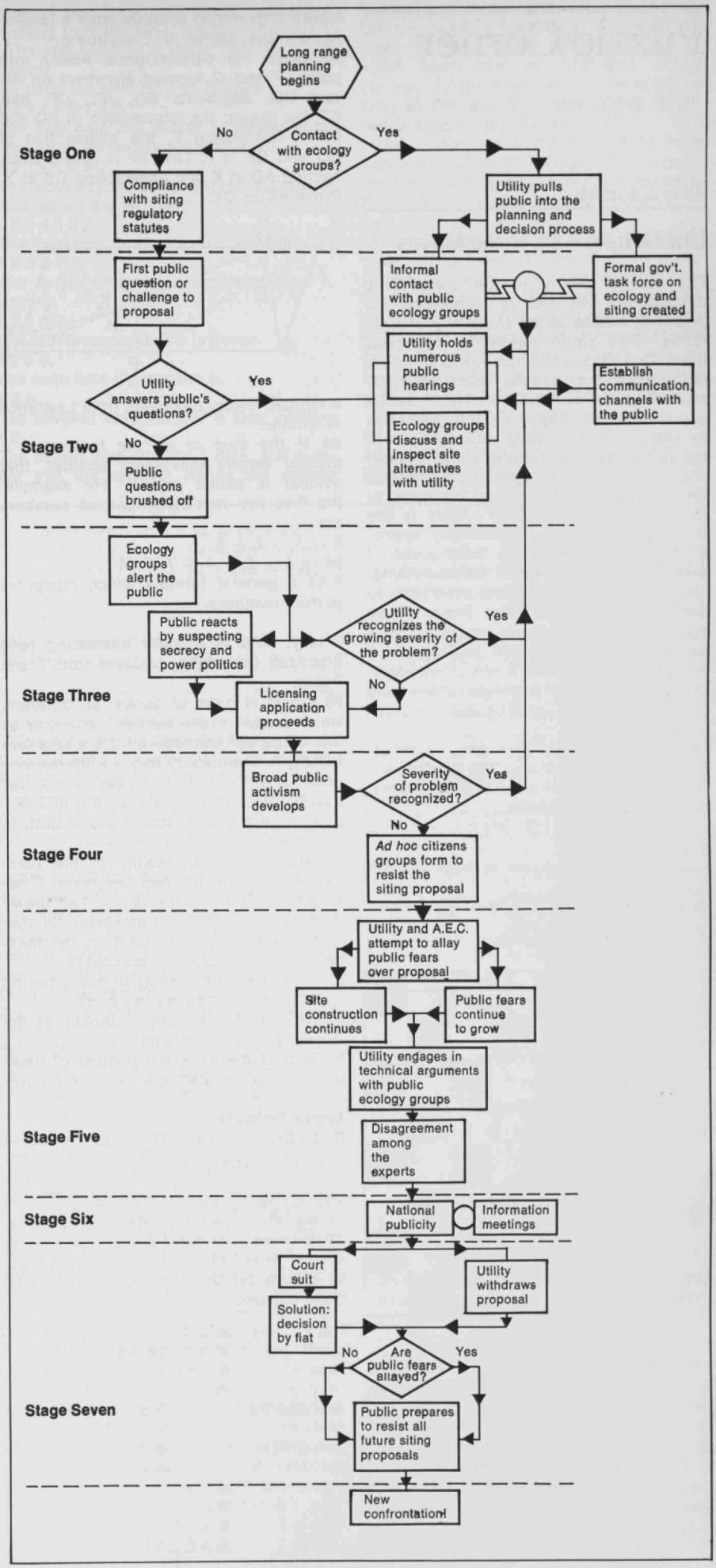
☐ Finally—"exploit opportunities to talk to people about nuclear power." This would consist mainly in keeping up to date with plans for public symposia and panel discussions, and providing them with speakers.

And will that fix them?

Maybe, and maybe not. The March issue of the American Nuclear Society's *Nuclear News* contained (pp. 32-35) an anatomy of the power struggle, reducing five such battles to the single flow-chart shown here.

The cases studied were: the Enrico Fermi plant, Lagoona Beach, Mich.; the Northern States Power proposal for Monticello, Minn.; the Pacific Gas and Electric proposal for Bodega Bay, Calif.; the Consolidated Edison proposal for Queensboro, New York City; and the New York State Electric and Gas proposal, Cayuga Lake, N.Y. Of these, the first went all the way to the Supreme Court, where the power company won, and the second resulted in a Supreme Court ruling against the state's bid for regulatory powers. The other three proposals were withdrawn.

In the flow chart, it will be noticed, there is an area (stage two, right) where arrows enter but do not leave. This stoppage is a (hypothetical) happy ending. The authors suggest that the succeeding stages could have been avoided, by "formal and informal efforts to incorporate the public in the decision-making process." No arrows emerge from this part of the chart because, in the cases studied, that is not the way it was done. The study, performed at the University of Texas, Austin, was the work of David G. Jopling (then a graduate student, now deputy director of the Southern Interstate Nuclear Board) and Prof. Stephen J. Gage, director of the university's nuclear Reactor Laboratory.



Conflicts between power utilities and conservationists can be generally represented by this flow-chart, according to a study at the University of Texas.

Puzzle Corner

Allan J. Gottlieb

Checkmate—In Three Moves

The natural beauty of the Santa Cruz campus (*Mr. Gottlieb is completing his graduate studies at the University of California—Ed.*) could hardly be improved upon. One reason the campus is so lovely is the scarcity of people. There are 4,000 students here and 2,000 acres of woods and meadows occasionally intruded upon by some building. While walking back to the dormitory one evening I met a deer; and after rubbing my eyes I tried to guess the chances of this happening back at M.I.T. The only complaint I have is the proliferation of signs describing appropriate action during an earthquake. I think they're trying to tell me something.

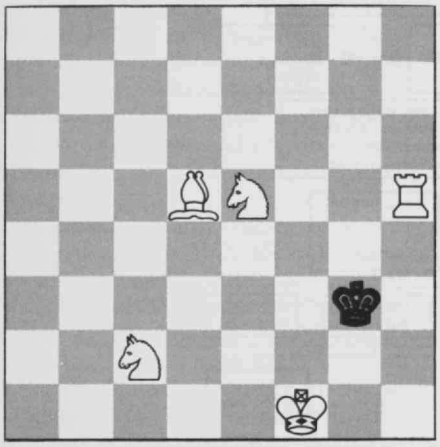
Many people favored chess problems, so they've been included. But there are so many chess and bridge columns that I cannot justify devoting 40 per cent of a Puzzle Corner to these forms of entertainment. Hence we'll alternate chess and bridge, with chess starting out the problems this month.

Remember to send problems, solutions, and comments to me at the Department of Mathematics, University of California, Santa Cruz, Calif., 95060.

Problems

The first chess problem is from Russell A. Hahigian:

51 Given the following, show how white can mate in three moves.

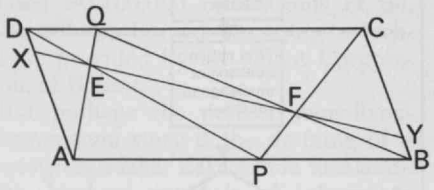


The following is from William H. Bean:

52 A railway car is travelling in a straight line at a constant velocity. A helium-filled balloon is tied to the floor of the car with a piece of string. The car is then decelerated at a constant rate. Relative to the car, what is the initial direction of movement of the balloon? What is the steady-state direction during deceleration (i.e., at what angle is the string to the floor during deceleration)?

Here's a geometry problem from a regular reader, Mrs. Martin S. Lindenberg:

53 Given the parallelogram ABCD with points P and Q located anywhere on AB and CD. Segments BQ, AQ, DP, and CP are drawn; the intersection of AQ and DP is designated E, the intersection of BQ and CP is F. Line EF is drawn intersecting AD at X and intersecting CB at Y. Prove AX = CY.



A number theory challenge from Lawrence H. Smith:

54 If the sum of all the factors of a number equals that same number, that number is called perfect. For example, the first two non-trivial perfect numbers are

$6 = 1 + 2 + 3$

$28 = 1 + 2 + 4 + 7 + 14$

Find a general formula which computes perfect numbers.

Finally, here is a really interesting (and practical) probability problem from Frank Rubin:

55 I own N pairs of socks, all different, which I wash every washday and sort by the following method: all 2N socks are initially in the laundry bag. I withdraw one sock at a time. If its mate is not yet drawn I place it on the bed; if it matches a previously drawn sock I place both in the drawer.

1. What is the probability of the number of socks on the bed becoming 0 between the first and the (2n − 1)th draw?
2. What is the expected maximum number of socks on the bed? (that is, the maximum over the 2N-step process)?
3. What is the probability of never having more than M socks on the bed?
4. What is the expected number in the drawer after K selections?
5. What is the expected number of times the pile on the bed will become empty?

Speed Problems

R. E. Crandall asks: Which is greater—1 or $(\sin 1 + \cos \sqrt{2})$?

The following bridge problem was sent to me and signed "courtesy of *The New York Times*": With the hands and bidding shown, what "killing" lead can West make to ensure defeat of the contract against good defense?

	♠ Q 2 ♥ A K 10 6 5 4 ♦ J 8 5 3 ♣ 3	
♠ K J 10 9 8 7 4 ♥ — ♦ A Q 10 4 ♣ K 8		♠ 5 3 ♥ Q J 9 8 7 2 ♦ 9 ♣ 9 7 6 4
	♠ A 6 ♥ 3 ♦ K 7 6 2 ♣ A Q J 10 5 2	

West	North	East	South
1 spade	2 hearts	pass	3 clubs
3 spades	pass	pass	3 n.t.
pass	pass	pass	

Solutions

36 If you are playing South, with clubs distributed as shown:

North
x, x, x
South
Q, J, 9, x, x, x

(the location of ♣ A, ♣ K, ♣ 10, and ♣ x being unknown), how should the suit be played to minimize the loss. You are in your hand with no way of reaching dummy.)

The following analysis is by Michael Kay, making the assumption that the defenders collect all the tricks coming to them: Play a low club first; this wins when the ♣ A or ♣ K is singleton (four times out of 16) and loses when the ♣ 10 is singleton (two times out of 16; the other ten cases are predetermined—the 4 0's and A-K-10-x splits always three tricks and 2-2's only two.

Also solved by Neil Cohen, Winslow H. Hartford, Elmer C. Ingraham, T. D. Landale, John W. Meader, R. Robinson Rowe, John P. Rudy, and Smith D. Turner.

37 A pipe can fill a tank in A hours, and the drain can empty it in B hours. If both are left on at the same time, it takes C hours to fill the tank. Show that there are an infinite number of *integers* A, B, and C which satisfy this problem; and find them.

This one must have been easy; even Joel Shwimer, my old next-door neighbor, solved it: The relation that must be satisfied is $1/A - 1/B = 1/C$, each side showing the fraction of the tank filled in one hour. Any set of integers A, B, C satisfying this relation will solve the problem. Let me consider a subset of all these solutions—namely, those solutions where $B = A + 1$. Now we have $1/A - 1/(A + 1) = 1/A(A + 1) = 1/C$. Therefore, choose any integer A (there are an infinite number of such choices). Let $B = A + 1$ and $C = A(A + 1)$. Both will be integers, and this will satisfy the problem.

Also solved by Robert L. Bishop, Gerald Blum, Neil Cohen, Harold Donnelly, Winslow H. Hartford, Mrs. Martin S. Lindenberg, John E. Prussing, R. Robinson Rowe, Frank Rubin, John P. Rudy, J. Richard Swenson, Paul G. N. de Vegvar, and Harry Zaremba.

38 It is not difficult to prove that $(x^n - x)/n$ is an integer when n is a prime number. (To avoid bickering, let x and n be greater than 1.) Can someone prove, or disprove, that if n is not prime, $(2^n - 2)/n$ cannot be an integer?

The following is from George E. Andrews of the M.I.T. Mathematics Department, who says the assertion of the problem is false. His proof:

When $n = 341 = 11 \cdot 31$, we note that $2^{10} = 1024$ and so $2^{10} - 1 = 1023 = 341 \cdot 3$ or $2^{10} \equiv 1 \pmod{341}$. Hence $2^{341} \equiv (2^{10})^{34} \cdot 2 \equiv 2 \pmod{341}$. If $2^n \equiv 2 \pmod{n}$, then n is known as a pseudo-prime. Sierpinski has pointed out that all of the Fermat numbers Φ_n are pseudo-

primes. This is seen as follows:
$\Phi_n = (2^2)^n + 1$ divides $(2^2)^{n+1} - 1$ divides $[(2^2)^2]^n - 1$ divides $[(2^2)^2]^n + 1 - 2 = 2^{\Phi_n} - 2$.
Φ_1, Φ_2, Φ_3 and Φ_4 are all primes; however, it is not known if any other Fermat numbers are primes. In particular, Euler showed that $(2^2)^5 + 1 = \Phi_5 = 641 \cdot 6700417$. It is known that Φ_n is composite for n = 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 18, 23, 36, 38, 39, 55, 63, 73.

Also solved by Neil Cohen, Harold Donnelly, John W. Langhaar, Ted Leahy, R. Robinson Rowe, Frank Rubin, and Harry Zaremba.

39 Take an arithmetic progression of mn terms and form it into an (m) x (n) matrix by making the first n terms the first row, the next n terms the second row, and so on. What is the rank of this matrix?

Harry Zaremba submitted the following: Let a = first term, d = common difference, and m, n $\neq$ 1. The (m) x (n) matrix will be:

a	(a + d)	· · · · · ·	[a + (n − 2)d]	[a + (n − 1)d]
(a + nd)	[a + (n + 1)d]	· · · · · ·	[a + (2n − 2)d]	[a + (2n − 1)d]
(a + 2nd)	[a + (2n + 1)d]	· · · · · ·	[a + (3n − 2)d]	[a + (3n − 1)d]
⋮	⋮		⋮	⋮
[a + (m − 2)nd]	{a + [(m − 2)n + 1]d}	· · · · · ·	{a + [(m − 2)n + (n − 2)]d}	{a + [(m − 2)n + (n − 1)]d}
[a + (m − 1)nd]	{a + [(m − 1)n + 1]d}	· · · · · ·	{a + [(m − 1)n + (n − 2)]d}	{a + [(m − 1)n + (n − 1)]d}

If the elements of any column i $\gtrless$ k are subtracted from column k, the elements of column k will all be equal and will be a multiple of the common difference d. Thus, if column 2 is subtracted from column (n − 1), all elements of column (n − 1) will equal (n − 3)d. In any square matrix [A] of third order or greater, the elements in two columns k and j (k $\gtrless$ j) will be multiples of d when the elements of column i are subtracted from them. When the resulting elements of column k are multiplied by a suitable factor and subtracted from column j, all elements of column j will be zero, and therefore the value of det [A] of the square matrix will be zero. Now, since the rank of a matrix is the order of its largest nonvanishing minor, the rank of the matrix above is two—because at least one of its minors of second order is nonvanishing. For example, the value of minor,

$$\begin{vmatrix} a & (a+d) \\ (a+nd) & [a+(n+1)d] \end{vmatrix} = \begin{vmatrix} a & d \\ (a+nd) & d \end{vmatrix}$$

$= -nd^2$.

Also solved by Gerald Blum, Harold Donnelly, John E. Prussing, Carl J. Rosenberg, R. Robinson Rowe, Frank Rubin, and Paul G. N. de Vegvar.

40 Nine men were captured by a strange tribe. All were seated in a straight line. The tribe always served a certain potion to its captives, with every seventh cup containing a deadly poison, and they always served from left to right, continuing from the last victim. They continued serving in this way until all but one prisoner died. They never killed the last man. If you knew this, which position—starting from the left—would you choose?

The last solution is from Paul G. N. de Vegvar:
We write the nine men as follows:
1 2 3 4 5 6 7 8 9.
The first time the potion is served number 7 dies, so we are left with:
1 2 3 4 5 6 8 9.
The second time it is served number 5 dies, so we are left with:
1 2 3 4 6 8 9.
The third time number 4 dies, leaving:
1 2 3 6 8 9.
The fourth time the victim is number 6, leaving:
1 2 3 8 9.
The fifth time, number 9 is gone:
1 2 3 8.
The sixth time it's number 3:
1 2 8.
The seventh time number 8 dies, leaving 1 2.
The eighth time number 1 dies, and number 2 is the survivor. Hence the answer is the second from the left.

Also solved by James W. Avery, Gerald Blum, Harold Donnelly, Winslow H. Hartford, T. D. Landale, Mrs. Martin S. Lindenberg, Michael Kay, John E. Prussing, R. Robinson Rowe, John P. Rudy, Joel Shwimer, and Harry Zaremba.

Better Late Than Never

Apparently the solution to problem **26** in the July/August issue was in error. The following is from James Kempner: Your readers (and you) seem to have been carried away by what appeared to be a successful "Deschapelles Coup" in the bridge problem. The play should show:

Trick	West	North	East	South
1	♣7	♣K	♣A	♣9
2	♦3	♦K	♦Q	♦2
3	?	♣Q	♣2	♥7(!)

If West does not ruff (trivial case), the hand is made, since the Declarer has to lose only two diamonds. If West ruffs, he has three choices: (1) A trump return is taken on the board by the ♠K; the ♣J is then cashed while discarding a diamond from South, leaving only one diamond to lose. (b) A heart return is ruffed by Declarer, the board is entered with a small spade to the ♠K, drawing West's last trump, the ♣J is played . . . (c) If West cashes his diamond and then exits with a diamond, the board ruffs and declarer has no more losers. He only has master trumps in his hand. Furthermore, if West overtakes the ♦Q with his ♦A and shifts to a spade, Declarer is then on the board; he can ruff a small club in his hand with ♠A, draw trump, and enter the board with a diamond to the ♦K and cash his two good clubs, discarding his heart and remaining diamond. If West overtakes the ♦Q with the ♦A and returns a heart to East's ♣A and East returns a club, South ruffs high and is again home free. In conclusion, I see no way to go down at four spades as long as the ♦A is on side giving South two entries to the board.

Other responses to **26** have come from Leonard V. Azaroff, Philip Bell, Harry L. Beohner, Connie Chase, Peter Friedland, David Gross, Leonard Lewis, Peter Lobban, and Frank Westcott.

The solution to problem **30** seems to have ruffled Frank Rubin's feathers a bit. He has written a six-page argument to establish that Mr. Heiberg's solution to his own problem "is about a full of holes as a Swiss cheese." Unfortunately space does not permit publication here, but interested readers may obtain a copy by writing to the Editors of the *Review*.

Other solutions have arrived:
22 Harold Blum
29 Roy G. Sinclair
31 Bowman Cutter

Books

David McCord, Peter Meyboom, John B. Wilbur, David G. Wilson

In the Midst of Life

A Care for Nature
Henry B. Kane
W. W. Norton and Co., New York, 1971, 159 pp., 71 ill., $6.00

Reviewed by
David McCord
Executive Director, Emeritus
Harvard College Fund

To begin with, the late Henry B. Kane was not only an original, intelligent, industrious human being: he was impossible to classify. He made a living by building and directing the M.I.T. Alumni Fund which, during his 24 years tenure, raised some $11 million for the Institution; but simultaneously he made a life for himself and his family managing a first-rate artistic mind which went into daily action long before the rest of us could even think of breakfast. A fisherman will cheerfully rouse himself at 4 or 5 a.m.; but Chick could do so every day the year round. Do so, and go to the drawing board.

Now many writers and artists, like the author and illustrator of *A Care for Nature*, have written, drawn, or painted "on the side." And in many cases, I suspect—as in one or two cases I know about—a twinge of weariness will show up in the product. Not so with Henry B. Kane. "Work to him," as E. M. Forster says of Gibbon, "was the same as amusement." I never saw a drawing or the sketch for a drawing he had made, or a piece of his urbane yet casual prose—for he has written as well as illustrated a number of excellent books on nature, though his popularity largely rests on his illustration of other people's work—or any fragment of his work which did not carry in it the open signature of joy.

He was a joy to know: an astonishing physical contradiction of the seedy naturalist, artist, woodsman, or thoreaurian. His dark hair, splendid moustache, tumultuous eyebrows, pallor of complexion, eyes holding you in focus, and a curious unplanned air of inner sophistication supported by his voice, suggested to the stranger that he had as lief be hastening out to conserve Las Vegas as a tract of woodland near his home in Lincoln, Massachusetts.

I never knew him out of sorts, or fractious with the world which must, of late, have troubled him. Whether he was preferredly two-dimensional or four-dimensional in outlook, I never ascertained. But I did know, as all of us who honored him well knew, that he loved above all the physical world into which he was born, that he gloried in the pageant of the sky, the heart of pond, meadow, and woodland; and that he gave his many ever-expanding talents to explaining them to those less gifted, less aware.

Any one who has ranged through a lifetime of reading cannot fail to see the merit of this small joyous book, which I am slow in bringing to the fore. It will, I feel perfectly certain, affect the lives of thousands who have never paused to read a nature book. It is (it will be for them) an easy book to enter; a difficult book to leave. Those who read it will share in the spontaneous joy of which I speak. They will not be conscious, of course, that he who wrote it and drew for it some of his very best birds, animals, and insects—he had a stroboscopic eye for this—did so while he was knowingly and rapidly approaching death. A more courageous ending of a life I cannot possibly imagine. There were no heroics about Chick. I am sure he never thought: "What can I leave my fellow man?" He simply left the key to a door which most people have never thought it worthwhile to open.

Of course he was a teacher at heart. If any college had had the wit to establish a Henry David Thoreau chair of nature history—for the roots, not the branches of learning, as Henry would have wished—Chick Kane could have occupied it. He was always "on the side of life"; and he would have agreed with Henry Beston that "peace with the earth is the first peace", which is what our sudden late-evolving theory of ecology is all about.

And ecology is what it is all about: under, on, and above ground, in the tiny front-and-back yard of the Kane family out in Lincoln. The other Henry, not so distant out in Walden, had a huge domain compared with this. But then the other Henry, or so it seems to me, was philosophizing first, and observing as he went. Henry Kane is observing and recording first: carefully, accurately, understandingly, and for the layman always; for the man and woman by the millions, that is to say, who own or rent a patch of ground to go with their small ranch or recycled farmhouse in suburbia, or subsuburbia, or with their summer camp.

A Care for Nature is a book which all the country bookstores, Shoppers Worlds, gift shops, the L. L. Beans, and airport send-off stores should carry. The normal book stores aren't enough for this prize Open Sesame.

It should have outlets where *Women's Day* and *Family Circle, Peanuts, Dr. Seuss, New Hampshire Profiles, Yankee, The Old Farmer's Almanac* are surrogate amid the fishing tackle, macaroni, frozen foods, and power mowers. *A Care for Nature* may just prove to be salvation for those whose world is bounded by the kitchen, car, TV, pool, camera, country clubs, and outboard. As the author dared predict in chapter one, these pages "will open unexpected vistas" to all who have escaped and are escaping daily from the city.

This is not the first book to attempt to train what Hudson called "a traveller in little things." Hudson tried it book after book over a long, long journey. Fabre, of course, was specialized and exhaustive; Thoreau rinsed every observation in philosophy; Darwin was remote; Muir, regional. Kane sticks to his own back yard for once, sits under his own trees on his small lawn in the midst of life. His eyes, his pen, and brush are yours; his field glass and his microscope; his knowledge and quiet voice. His discoveries are yours; and yours his friendship and continued enthusiasm. If you don't know them, you will meet for the first time the pale crab spider in the marigold, the deadly ambush bug, the swift wolf spider, ant-lion, and the charming white-feet—who could call them mice? You will meet the normal flow of birds, the animal inspectors night and day. You will hear sounds you never recognized, see courtships (like the flickers') unimagined. You will not be troubled by Latin names, or any "I know this; you don't." Lastly, you will be enchanted by the drawings of a master among naturalists. Henry Kane as a boy read Sir Charles G. D. Roberts' books such as *Red Fox, The Feet of the Furtive, The Watchers of the Trails* (even as I did). But his inspiration was in the unforgettable illustrations by Charles Livingston Bull. I said that Chick had stroboscopic eyes. If you do no more in a bookstore than open to page 134 and inspect that robin looking straight back (owl-like) over its back, you will end by inspecting the 70 other illustrations. The pictures do not show it, but the prose is true to nature, innocent and otherwise. "In this quiet garden lurk strange killers and death." But miracles are there as well.

"Either They Stand Up Or They Fall Down"

A Span of Bridges: An Illustrated History
H. J. Hopkins
Praeger Publishers, Inc., New York, N.Y., 1970, 288 pp., $12.50

Reviewed by
John B. Wilbur
Senior Lecturer
Department of Civil Engineering, M.I.T.

Back in the twenties and the thirties when the late professor Charles M. Spofford was head of M.I.T.'s Department of Civil and Sanitary Engineering, he used to give a talk on the history of bridges to his students in fourth-year structures each spring. With pointer in hand, and with the help of black and white slides which he had collected over the years, he began with a stone arch over a doorway in "the temple of the Moon God at Ur, near Bagdad," and with the early bridges of Rome and the still-preserved Pont du Gard. From these he went on through structures such as the remains of the bridge at Avignon, the shop-lined Ponte Vecchio, the rectangular tubes of the Britannia Bridge, the cantilever across the Firth of Forth, and on up to the then more recent achievements such as the Quebec Bridge and the Hell Gate Arch.

It is inevitable that Hopkins' *Span of Bridges* with its story told in terms of the "engineering principles involved and the great bridges built" should, to this reviewer at least, evoke such pleasant memories. And these can only be strengthened when we read of the people involved, of their disasters as well as their triumphs, of Eads and Cooper and

their great bridge across the Mississippi at St. Louis, for example, or of Bouch and the ill-fated trestle over the Firth of Tay, or of Cooper and the failure of the cantilever arm of the first bridge over the St. Lawrence River at Quebec. Hopkins is at his best when he tell us of episodes such as these.

But *Span of Bridges* goes well beyond being simply a narrative. In telling of the engineering principles involved as well as of the great bridges built and of the people who built them, Hopkins is to be commended, and especially so because he undertakes to do this in simple, nontechnical terms that are aimed at bringing at least some degree of understanding to the layman who does not have the mathematical background to follow the abstractions of sophisticated analyses. His introduction to such an approach is so simply-stated that it deserves being singled out as an example: "Man lives in a gravitational field," he tells us, "and gravity is fundamentally a pull—a tensile force. Therefore any body which is directly in contact with the earth and in equilibrium with gravity, transmits an equal and opposite force—a push or compressive force. Stones placed on top of one another are maintained in place by exerting on each other this kind of force, and the requirements of equilibrium are determined by the act of placing the stones. Either they stand up or they fall down."

From this simple beginning we are led from one type of structural action to another: to the concept of an arch as the inversion of a chain supported at each end; to the bending of beams and of trusses composed of members in tension as well as in compression; to suspension bridges and to a consideration of their aerodynamic instability; to monoliths of reinforced concrete and even to prestressed concrete structures. Just how readily these non-mathematical explanations of the more complicated structural actions can be grasped by one who does not already have considerable knowledge of them, is difficult for this reviewer to assess; but the approach has merit, in any event. If the novice can strengthen his intuitive feel for structural actions, he is in a better position to benefit by the great contributions that can then be made by mathematics and by experimentation. The fact that no single approach to structural understanding is all encompassing should not prevent us from exploiting each avenue to its fullest.

Our excursion through structural performance is not without mention of the people involved. There is Hooke, whose work on "elasticity or springiness" found more immediate application in regulating "all parts of Watches or Timekeepers" than it did in promoting the science of bridge engineering; there is Young, of Young's Modulus fame; there are Bernoulli, Euler, Coulomb, Bow and Varignon; and there are a host of others. But, Hopkins states, "discoveries by natural philosophers (as physicists were then called) never have been quickly adopted by engineers." There is an implication here with which this reviewer is not in full agreement—that engineering applications usually follow analytical understanding. Often the engineer breaks new ground through building something that is imperfectly understood; and the behavior of his product—be it satisfactory or not—points up problems that need further analysis. Whichever may come the first, however, there is no gainsaying Hopkins' contention that there is need for closer cooperation between engineering and science.

Span of Bridges is unique in that it covers so many phases of the art and science of bridge construction. The wealth of illustrative structures ranges from bridges built before the birth of Christ to the modern bridges of Maillart and Fressinct, from Telford's chain bridge over the Menai Straits to the great Verrazano Suspension Bridge that "breaks the wide estuary" between Staten Island and Brooklyn. All this, and with a wealth of detail, comprises a source of information that will find value on many a bookshelf. It is the kind of volume which those interested in bridges will read with considerable satisfaction, and to which they are likely to make frequent reference over the years to come.

For Recycling Freaks

Reuse and Recycle of Wastes: Proceedings of the Third Annual North Eastern Regional Conference, University of Rhode Island, July 21-23, 1970
Stamford, Conn., Technomic Publishing Co., 1971, 243 pp., paper bound $15.00

Reviewed by
David G. Wilson
Professor of Mechanical Engineering
M.I.T.

The competition among people organizing symposia on the environment is nowadays so strong that the claims which are implied by the titles of their proceedings are escalating in the manner of soap advertisements. The reuse or the recycle (the distinction between 'reuse' and 'recycle' is not clear) of wastes is obviously an attractive theme. Would it have been more attractive as the reuse, recycle and reclamation of wastes? One question a reviewer should answer for the prospective reader is: does the title represent fairly what is inside? And the answer inevitably is: yes, and no.

The reader who expects a broad review of the whole field of recycling, or alternatively an in-depth analysis of one aspect, will be disappointed. This is a collection of 16 miscellaneous papers on air, water, and solid-waste pollution, apparently unedited and unexpurgated, containing the usual quota of self-serving plugs for particular products or approaches, without discussion or criticism which would enable someone new in the field to evaluate the worth of each paper, and in some cases having only the most tenuous relationship with the theme implied by the title. It is a hodge-podge—a reader's digest for the recycling freak. And some of the individual papers are delightful.

Incentives against People Pollution

One of these, incidentally having no particular connection with the general theme, is Fred Singer's "Is There an Optimum Level of Population?" It is more of an address, an exhortation, even a sermon, than a paper. The topic was examined from many aspects at a previous meeting of the A.A.A.S., and Singer's concern is to keep the discussion alive. He assails our preoccupation with what he calls "first-order effects"—our delight with technological discoveries, with more and cheaper goods—and our unconcern with the secondary effects that stem from them. The "technological fix" may save us from drastic lowering of our standard of living for a decade or two, but each new fix usually makes a smaller step change than the one before—primary sewage treatment can be followed by secondary and then tertiary treatment, but after that the laws of conservation of matter and of energy begin to make absolute limits on effectiveness.

He draws a parallel, an implied one, between the technological fix to a pollution problem and the dispersion fix to the (local) overpopulation problem. It is obvious to visitors to the United States from Europe that this country is grossly underpopulated by the standards of much of the world. What seems to be needed first is to start new centers of population growth and limit by some means the growth of large cities. Dr. Singer takes it as being desirable that cities not be allowed to grow at random, and calls for more research into the "quality of life" and all that this woolly term implies.

This reviewer has always found it fascinating that whereas at one extreme we limit the number of people who may live in houses, and the number who may enter countries at the other, we have made no real effort to make the same determination as regards cities. There have been several attempts to limit their physical size. Medieval cities had walls; many modern cities have green belts, and in both cases the limits hold for a while and then usually are breached. Why don't we do something about the incentives that make cities grow? It is obviously cheaper for people to attach themselves to an existing city with its established infrastructure of services of all sorts than to start again from nothing. We even encourage uncontrolled growth through taxation policies that produce lower real-estate taxes the further out one lives from a city center. How about changing the rules by making tax rates rise the further out one chooses to live, thereby giving a subsidy to the people who got there first and deserve some preservation of the quality of services which the suburban new arrivals are helping to erode? Let us hope that Dr. Singer will be examining changing incentives as well as changing restrictions.

Controlling Indoors Pollution

The second paper which this reviewer found of great value and interest was "The Reuse of Interior Air" by Peter Kalika and others of the Research Corporation of New England. One can go to interminable antipollution conferences and listen to people lamenting what others are doing to our environment, puffing smoke into a usually limited quantity of shared air while they talk. Kalika's paper was the first attempt known to this reviewer in which there was any questioning that air pollution was anything

other than an outside phenomenon. It attracted national attention in scientific and engineering journals from editorial writers and others who are both mystified and appalled at a situation in which so many continue to allow the tyranny of a few. Kalika reports on a series of measurements in Hartford on indoor and outdoor pollutant measurements at two air-conditioned office buildings in Constitution Plaza. A rather limited range of pollutants was measured: respirable and total suspended particulate matter, "soiling" particulate matter, carbon monoxide, and sulfur dioxide. Measurements were made far outside the buildings, nearby, just inside, and deep inside. Significantly, the inside measurements were made in an unoccupied office. A summary of results showed that the concentration of total particulates was always less than outside; however, the particulates in the range designated as "soiling" could be at a higher concentration inside than outside. The startling result concerns carbon monoxide, which averaged 2.47 parts per million (p.p.m.) outside. The inside concentration, in an unoccupied room, was higher, and averaged 3.19 p.p.m.

The authors make some common-sense recommendations. Since buildings of the size being examined behave almost like sealed boxes, despite the provision for so-called fresh-air makeup, it is important to ventilate the building every day. They hypothesized that building superintendents may frequently ventilate just before the start of the regular office day, so that the CO concentration from the morning traffic peak is captured and the office workers are confined in it through the rest of the day.

In this collection there are other papers which will have particular interest for different people, and this choice of which to review is subjective. The book deserves a place in any collection of general works on antipollution activities.

Codifying Rights and Responsibilities

A Digest of Environmental Pollution Legislation in Canada
Canadian Industries Ltd.
Montreal, Canadian Council of Resource Ministers, 1970, approximately 700 unnumbered pages, $10.00

Reviewed by
Peter Meyboom
Department of Finance
Canada

Jurisdiction over environmental quality in Canada is divided in a most complex fashion between the federal and provincial governments. With respect to water, the federal government's legislative jurisdiction is considered dominant in the case of international, boundary, and coastal waters, while some authorities feel that the federal government has a "major" jurisdiction over interprovincial waters. The federal government does have exclusive legislative jurisdiction over navigation and fisheries and concurrent jurisdiction over agriculture. The provinces, on the other hand, enjoy proprietary rights over land and other natural resources within their boundaries. This, coupled with other powers, gives them the right to allocate these resources and to regulate their use. With respect to air, the division of responsibilities is not nearly so clear, and most provinces deal with questions of air pollution under provincial health acts.

This complex and sometimes confusing array of rights and responsibilities has been arranged neatly by province and subject matter in this *Digest* prepared by Messrs. N. E. Cooke, R. M. Cooper and Jacques Pilon of Canadian Industries Limited. An introductory letter by the President of C.I.L. explains that the *Digest* had originally been compiled to ensure that the manufacturing operations of this large chemical company would not violate environmental standards across Canada. The present edition, which is the fourth since 1961, was made available by C.I.L. to the Canadian Council of Resource Ministers "as a contribution . . . to the solution of the problem of environmental improvement."

Apart from being a comprehensive and useful guide on Canadian environmental legislation for the practicing engineer, the *Digest* is an interesting document from a sociological point of view as it demonstrates how the various provinces in a federal state approach the problem of environmental management. Only three provinces—British Columbia, Newfoundland and Manitoba—have comprehensive legislation that applies equally to water, air and soil pollution. The Province of Alberta deals with all aspects of pollution control through the provincial Public Health Act, whereas all of the other provinces—New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec and Saskatchewan—deal with water pollution through specific water acts. Of these, only Ontario and Saskatchewan have air pollution control acts and none of them have specific acts dealing with soil pollution. In those instances where no specific pollution legislation exists, the provinces appear to rely chiefly on public health acts.

Although the *Digest* gives a helpful and detailed overview of laws and regulations that governed pollution control in Canada until 1970, the reader should be aware that environmental management in Canada is in a state of rapid development. During the last parliamentary year for instance, five major pieces of federal water management legislation have been enacted, all of which have great importance for pollution control. These are the Canada Water Act, the Arctic Waters Pollution Prevention Act, the Northern Inland Waters Act, an Act to Amend the Fisheries Act, and an Act to Amend the Canada Shipping Act. None of these acts is included in the present edition of the *Digest.*

The authors of the *Digest* are aware of these inevitable shortcomings and they indicate in their foreword that the publication of occasional supplements and updated editions is envisaged. In view of the importance of the matter, and the rapidly expanding legislation, one hopes that the Canadian Council for Resource Ministers will soon publish the first supplement to this useful but already incomplete document.

Special Report

Jerome B. Wiesner (left) and Howard W. Johnson had been close collaborators for the five years of the latter's Presidency of M.I.T.; but one could still wonder, what were their thoughts while waiting for Dr. Wiesner's simple inaugural to begin on October 7 (above)? Moments after this picture was made, Mr. Johnson captured the sense of his successor's qualities of intellect, liberalism, and humanity: "His credentials as one who has defended liberty are so secure . . ." (Photo: Alfred I. Anderson, '71)

An Unconventional, Emotional Inauguration

If the pageant and ceremony of a conventional academic occasion celebrate the university in its ivory tower of scholarship, why not seek a different, less majestic (and less expensive) form—which might express a university's growing need to interrelate productively with the outside world—to celebrate the start of M.I.T.'s 13th Presidential administration?

Reasoning along such lines, the faculty committee charged with planning the inauguration of Jerome B. Wiesner this fall proposed a community celebration built mainly around a two-week series of seminars surveying the fields and means through which M.I.T. will seek to make its principal contributions in the next decade. Two panel discussions, one on educational frontiers and the other on future research opportunities, would precede a simple inaugural ceremony, with President Wiesner receiving the Charter of the Institute and delivering his major address in the presence of the entire Institute community—but without the usual delegations representing sister institutions and alumni.

Other events—a community reception, art exhibitions, luncheon, drama, motion pictures, and a symphony-choral concert—were planned to add a "sense of quality and exhilaration," according to Peter Elias, '44, Cecil H. Green Professor of Electrical Engineering, who was Chairman of the committee.

If attendance at the score or more of events which materialized under this plan is the criterion by which success be measured, then the program must be judged wanting. For few seminars drew audiences of over 50, and the capacity of Rockwell Cage was scarcely tested for the inauguration ceremony itself. But the "participation potential" of the M.I.T. community seems low this year for all kinds of events and activities, according to Kenneth R. Wadleigh, '43, Vice President. Instead, he told the M.I.T. Administrative Council shortly after the inauguration, "classroom attendance is up significantly," and the low participation in inauguration events may be a sign of the community's seriousness of purpose, not its apathy.

But such uncertainties and frustrations were forgotten as the climax arrived:

For three weeks early this fall gold and crimson bulletin boards (left) proclaimed a plethora of events—seminars, movies, performing arts, receptions—to mark the inauguration of Jerome B. Wiesner. Panels on teaching and research (opposite) were mixed with social events: a Great Court reception (left) for students and staff; a second reception (below) for inaugural guests to greet both the Wiesners and Dr. and Mrs. Paul E. Gray; and a historic gathering (bottom) of five generations of M.I.T. leadership: Dr. Wiesner, Vannevar Bush, '16, Howard W. Johnson, Julius A. Stratton, '23, and James R. Killian, Jr., '26. (Photos: Margaret Foote and Alfred I. Anderson, '71)

☐ On Wednesday, October 6, a festive noontime concert of fanfares, sonatas, tunes and airs in the Rogers Building lobby—and echoing through the adjacent corridors—by five young people coming together as the Cambridge Symphonic Brass Ensemble.

☐ On Wednesday evening, when Pete Seeger joined the M.I.T. Symphony and choral groups and sang of engineers having been to the university, making their lives in "boxes, little boxes, and they're all made out of ticky-tacky."

☐ On Thursday noon, when Senator Edward M. Kennedy, speaking at a luncheon for inauguration guests, recalled his family's long-time affection for M.I.T.'s new President; Dr. Wiesner's work on the nuclear test ban treaty when he was White House science adviser, Senator Kennedy said, "pushed us away from the brink of a nuclear holocaust."

☐ And—the most moving moment of all—when Dr. Wiesner turned from the audience to embrace his long-time friend Archibald MacLeish, who had just read his unique poetic tribute (*see page 13*). Dr. Wiesner was clearly so touched that only with difficulty could he begin his formal inaugural address a moment later.

No one who shared the experiences of the inaugural events could doubt that M.I.T. had a new leader cut from a somewhat different cloth. As Howard W. Johnson, Chairman of the Corporation, said while presenting the Institute's charter to Dr. Wiesner at the inauguration ceremony, "His credentials as one who had defended liberty are so secure that he will be a stronger voice for those old virtues whose need has never been greater, whose value never dearer—courage, achievement, and honest patriotism."

Research and Education, Beauty and Relevance

Seeking a new format to replace the conventional dissertations, the faculty committee planning the inauguration of Jerome B. Wiesner as 13th President of the Institute proposed two weeks of seminars and dialogues to focus on "self-assessment and self-projection"; sessions were encouraged on all subjects currently pertinent and likely to grow in importance in the next decade at M.I.T. There were no plans to invite large numbers of "outside experts," for the emphasis was to be not on opening large new issues but rather "to examine what's already being done," Peter Elias, '44, Chairman of the Inauguration Committee, told *The Tech*.

The result was a series of events on topics already generally familiar at M.I.T., by people already known to be associated with them. Students unfamiliar with the range of M.I.T. research and teaching could hardly fail to find the two-week series instructive—if they took time to attend a fair share of the 50 or more events. Those who follow the range of efforts through which M.I.T.'s technology seeks to fulfill social needs found illuminating new expressions of old problems but only occasional turns in new directions.

A sampling, assembled by various members of the *Review's* staff and reporters for other campus publications:

☐ *On controlling technology:* Jack P. Ruina, Professor of Electrical Engineering, proposed that controlling government-sponsored technology is fairly simple, because the controls—including those of both the Legislative and the Executive—are within the government establishment. Means for controlling the technology exploited by industry and individuals are far less obvious, he said. But George W. Rathjens, Professor of Political Science, challenged this view: control within the government is inhibited—perhaps rendered impossible—by classification and by the fact that government agencies charged with controlling activities are sometimes co-opted by the very groups under the agencies' control; he cited as examples of the latter the Federal Communications Commission, Federal Aviation Administration, and Atomic Energy Commission.

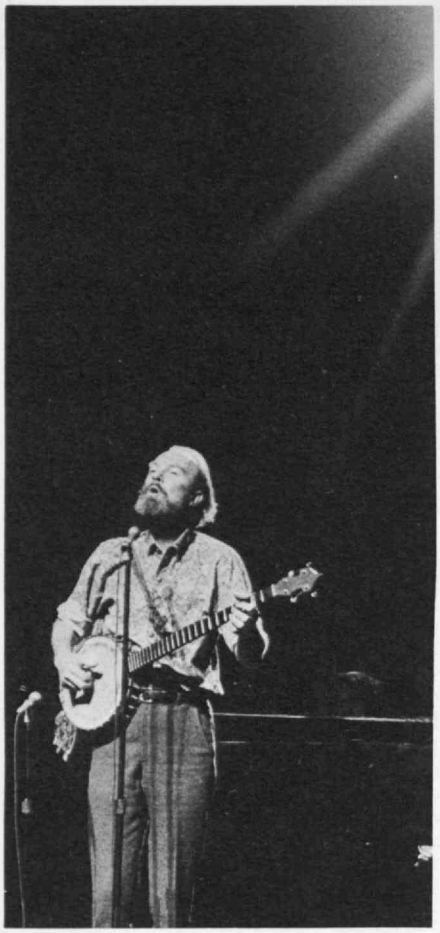
☐ *On educational methods and motives:* Students in this generation are very different from their predecessors—less directed, more interested in exploring several different ideas and directions than in pursuing a single professional goal. But Travis R. Merritt, Associate Professor of Literature, foresaw a danger: too much variety may isolate students intellectually by eliminating their common background. "The critical question," he insisted, "is how man develops relationships that work toward community rather than fragmentation." And Franco Modigliani, Institute Professor and Professor of Finance in the Sloan School of Management, raised the practical suggestion that, despite this apparent interest in undirected programs, current economic conditions and job prospects do in fact have an effect on students' choices. Others on the panel, including Peter A. Messeri, '72, Chairman of the Student Committee on Educational Policy, found it "chilling" that educational choice should be thus governed by the market. "I cherish the view that students can make an independent choice of discipline," he said, pursuing undergraduate studies "for the sheer joy of learning."

☐ *On research programs:* Carroll L. Wilson, '32, Professor of Management, called attention to the rule of the reward system as a factor in any effort to "convert" from military to nonmilitary research. Through the years, he said, military research has been well rewarded in financial as well as in less tangible ways. If, as he believes, society is ready to support new research areas, is there now a basis for a similar reward structure for nonmilitary work? But Robert M. Solow, Professor of Economics, felt that this problem was no more than "a marginal issue."

☐ *Technology and ethics:* If the whole of the scientific revolution to date represents man's effort to increase his power, is it fair to assume that science and technology have succumbed irrevocably to this human weakness? Having posed the question, Dr. John Wren-Lewis of the Imperical Chemical Co., Ltd., also proposed an answer drawn from what he described as a Wagnerian "trip," a sudden vision in a shaft of brilliant sunlight over a Swiss lake: a scientist can separate his work from its mercenary motives if he gives more attention "to himself and his inner life, to what science can do for a scientist. . . . We must avoid seeing patterns in the world that we want to see," said Dr. Wren-Lewis, "and pay more attention to the patterns that arise in inner life." Philip Morrison, Professor of Physics, was troubled. "The scientist," he said, "is distinguished by what he has done. . . We must discuss what we have learned about the world as well as why we have learned it."

☐ *On new values in engineering education:* What we seek now is to teach and practice "societal engineering," said J. Herbert Hollomon, '40, Consultant to the President and Provost of M.I.T. This is a new form of the traditional discipline which goes beyond engineering "in the hardware sense." The societal engineer would provide "the engineering of total delivery systems—health, education, and transportation, for example." But Dr. Hollomon does not mean systems engineering, because the latter is not largely concerned with the "deepest kind of political, social, and psychological interactions." Dr. Hollomon's engineer-of-the-future would be comfortable with extreme complexity and with the political, social, and psychological—as well as the technical—value of his designs.

☐ *Another view of the breadth of modern engineering practice:* Assume we're concerned with a technological system's response to various stimuli, said Fred C. Schweppe, Associate Professor of Electrical Engineering. Once we could worry about the effects of a small stimulus—turning on a houseful of 40-watt lights, for instance. But now we have to be worried about one of a different order of magnitude: "Suppose a million people decide each to install a kilowatt's worth of air conditioning." Can we really un-



derstand and deal with such problems? Not yet, agreed Louis D. Smullin, S.M.'39, Head of the Department of Electrical Engineering. And another member of the seminar added that the trouble is that "we don't do interdisciplinary work at M.I.T. We do multidisciplinary work, and when it's all finished we integrate it with a stapler." But look out, warned Laurence R. Young, '57, Professor of Aeronautics and Astronautics, "just because it's interdisciplinary doesn't mean that it's good." And another word of caution from Victor F. Weisskopf, Head of the Department of Physics: "To do something well, you first have to learn something. . . . We have to educate people who know their stuff."

☐ *Transportation research and M.I.T.:* There is more than a little bewilderment about how to use academic resources to help solve nuts-and-bolts problems. Alan A. Altshuler, Professor of Political Science on leave as Massachusetts Secretary of Transportation, needs research people accustomed to working with deadlines; but as a teacher he knows that deadlines are incompatible with the concept of university research: it must be free of daily pressures to be most useful and creative. Herbert H. Richardson, '53, Professor of Mechanical Engineering on leave as Chief Scientist at the U.S. Department of Transportation, agreed, noting that only 0.2 per cent of D.O.T.'s total budget goes into university research. But "the best young minds are in the universities, and that is the place to stimulate them to think about transportation," he said. Or you can look at it another way: the universities can raise the country's general competence to deal with broad interdisciplinary problems, and you can then fairly expect that much specific innovation will arise from such a competence. To this dialogue A. Scheffer Lang, '49, Professor of Civil Engineering, added a similar plea: let the universities remember that they are primarily educational institutions.

☐ *Science for itself:* This emphasis on finding ways to bring engineering to modern problems found another antithesis when Philip Morrison, Professor of Physics, told a seminar that, though he is "not at all for irrelevance," the fact is that "the world is what we study, and the problems of men are also in the world." When we teach physics, said Professor Morrison, "we must do our best to connect physics with the rest of human culture. . . . I want to show [a physical phenomenon] because it is beautiful, because it is striking," not really because it may be useful.

The performing arts during the inauguration of Jerome B. Wiesner: top to bottom—folk singer Pete Seeger at the concert by the M.I.T. Symphony and Glee Club; an evening of one-act plays by the Dramashop; noon-hour fanfares by the Cambridge Symphonic Brass Ensemble; and the dance company of the National Center of Afro-American Artists. (Photos: Alfred I. Anderson, '71, and Margaret Foote)

The Guthrie-Wiesner Alliance

Unexpected joys—and a few other surprises—awaited the only "standing-room-only" audience of the inauguration at the concert in Kresge Auditorium on October 6. The program could hardly have been more varied: electronic music, the M.I.T. Symphony, a flute-and-piano duet, Lillian Hellman introducing Pete Seeger, and the M.I.T. Glee Club and Choral Society.

All the mixing did not yield a perfect blend; the M.I.T. Symphony was a bit too small so early in the academic year for as large a piece as Brahms' Academic Festival Overture, and the Psalms by Ross Lee Finney and Charles Ives, conducted by Klaus Liepmann, Professor of Music, seemed almost a formal glorification after Pete Seeger's free and sometimes moving tribute to the 13th President.

But when they came to the smaller Concerto for Clarinet and Orchestra by Mozart, soloist Ray S. Jackendoff, Sc.D.'69, and the M.I.T. Symphony, this year under the direction of Robert S. Freeman, Associate Professor of Music, found exactly their medium of praise. Lillian Helman, the playwright who has recently been Visting Professor of Humanities at M.I.T., charmed the audience with her plea that "artists and scientists are in the same world, and they should be on the same side" and her assurance of Jerome Wiesner's deep commitment to "what science can do for the happiness and life of man."

Then came Pete Seeger, who had first met Dr. Wiesner when the latter was recording American folk music for the Library of Congress before World War II. Introducing his last number, "This Land Is Your Land," Mr. Seeger noted that "the combination of Woody Guthrie and Jerome Wiesner is the kind of alliance the world needs"—and so it seemed to all who joined in the ensuing singalong.

The concert opened on still a different theme—a stageful of musicians but none of them playing during the performance of the "Inaugural Fanfare for Digital Computer" by Barry L. Vercoe, Assistant Professor of Music at M.I.T. Program notes explained that the work's 12-note theme was derived by associating the letters j-e-r-r-y-w-i-e-s-n-e-r with corresponding ordinal numbers" and projecting their respective residues mod 12, mod 11, . . . onto the available notes of the chromatic scale."

The Inaugural Committee announced in the program that a piece especially for the occasion had been requested of the late Gregory Tucker, Professor of Music, before his death last summer. That work not having been completed, the program included Mr. Tucker's "Merwan Songs" performed by Karl Kraber, alto flute, and Frederic Rzewski, piano.—J.M.

"I Love this Man" . . . "Who Has Defended Liberty"

Between them, Archibald MacLeish and Howard W. Johnson said almost all there was to say about Jerome Bert Wiesner upon the latter's inauguration as the 13th President of M.I.T.

They shared the center of the Rockwell Cage platform with Dr. Wiesner and James R. Killian, Jr., '26, Honorary Chairman of the Corporation, during the simple late-afternoon ceremony on October 7. There was music by the M.I.T. Concert Band (John D. Corley, Jr., Conductor) and the M.I.T. Brass Choir (Felix Viscuglia, Conductor); no processional and no assemblage of learned societies' and institutions' delegates; no academic regalia. Eight honored guests joined the principals: Vannevar Bush, '16, Former Chairman of the Corporation; Paul E. Gray, '54, Chancellor; Paul V. Keyser, Jr., '29, President of the Alumni Association; William M. Mack, Jr., '68, President of the Graduate Student Council; Hartley Rogers Jr., Chairman of the Faculty; Walter A. Rosenblith, Provost; Robert N. Schulte, '72, President of the M.I.T. Undergraduate Association; Julius A. Stratton, '26, President-Emeritus; and Alfred E. Vellucci, Mayor of Cambridge. Most members of the Corporation, many faculty and staff and their families, personal guests, and several hundred alumni and as many students were present; but the audience was smaller than for the usual M.I.T. Commencement.

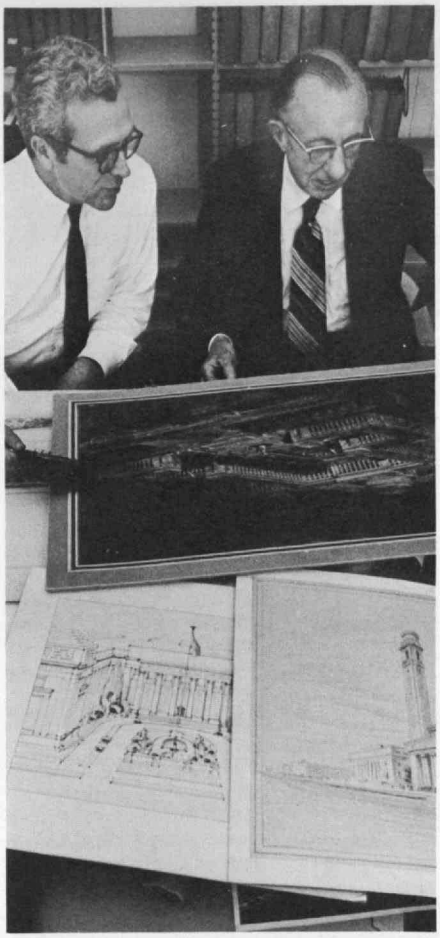
Dr. Wiesner was his closest colleague during the five years when Mr. Johnson was President of M.I.T., and it is no secret that he was the President's choice to take his place when a year ago Mr. Johnson announced his intention to retire. His praise for Dr. Wiesner on October 7 was eloquent: "Even above his intellectual capacity, which is large; his abilities, which have been demonstrated; and his accomplishments, which are many; I place the quality of the values he holds for our society, his humanity for his fellow man, his dedication to education and to students, and his passion for M.I.T.

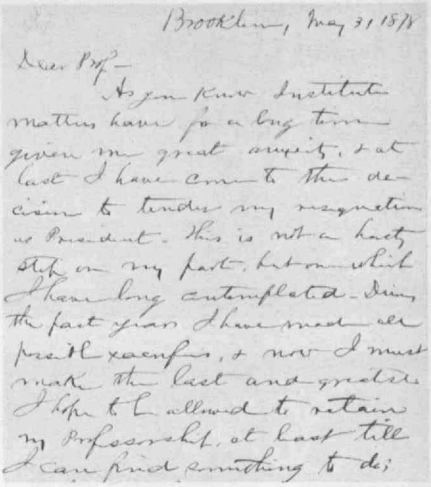
"His credentials as one who has defended liberty are so secure that he will be a stronger voice for those old virtues whose need has never been greater, whose value never dearer—courage, achievement, and honest patriotism," Mr. Johnson said.

Then came Mr. MacLeish, who was Librarian of Congress when Dr. Wiesner first went to Washington as an engineer for the Library's program to record American folk music, delivering his "Speech on a Public Occasion for Jerome Wiesner" *(see page 13).* "I love this man," wrote Mr. MacLeish. . . . "Congressional committees hear him say: 'Not what you think: what you haven't thought of.' He addresses Presidents. He says: 'Governments even now still have to govern; no one is going to invent a self-governing holocaust.' The Pentagon receives his views: 'Science,' he says, 'is no substitute for thought. Miracle drugs, perhaps; not miracle wars.' "

Though neither could have known the other's plans, Dr. Wiesner concluded his inaugural address *(see pp. 15-18)* with a powerful, if apologetic, "invasion of Mr. MacLeish's craft:"

"No equation can divine the quality of life
no instrument record,
no computer conceive it.
Only bit by bit can feeling men,
lovingly retrieve it."

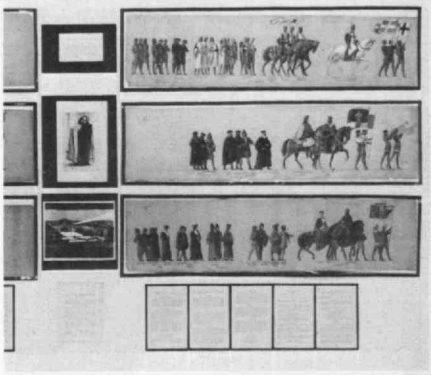


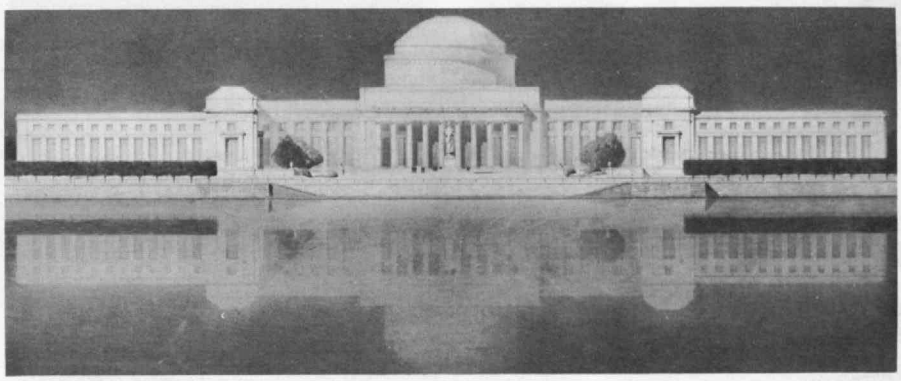


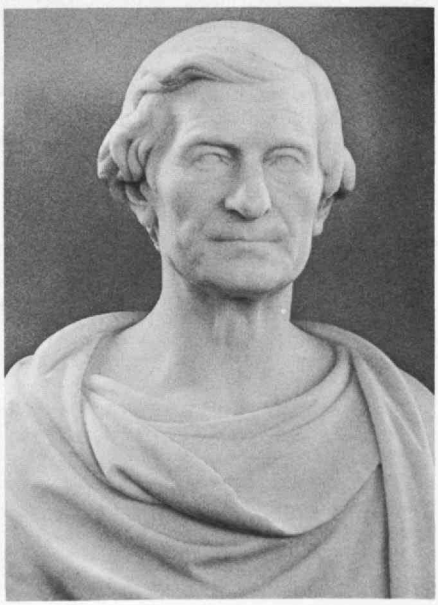
Brookline, May 31 1918

Dear Pres[illegible]—

As you know Institute matters have for a long time given me great anxiety, & at last I have come to the decision to tender my resignation as President. This is not a hasty step on my part, but one that I have long contemplated. During the past years I have made several tentative efforts, & now I must make the last and greatest. I hope to be allowed to retain my Professorship, at least till I can find something to do;







Assembling an inaugural exhibit of M.I.T.'s history gave Professor Richard M. Douglas (left), a relative newcomer, a lesson in the fascination of the Institute's past with Professor E. Neal Hartley, Archivist. The result was a corridor show which included the letter of resignation of John D. Runkle, M.I.T.'s second President; the ceremonial crossing of the Charles in 1916; a rendering never before shown in Cambridge of Welles Bosworth's ('89) design for the new buildings; and the resurrection from a dusty storeroom of a forgotten marble bust of William Barton Rogers, founder of M.I.T.

Institute Review

Welcoming the Class of '75 . . .

The Class of 1975 arrived this September like scores of classes before it—a little confused, but eager to become oriented and begin work. Like its immediate predecessors, the class had more long hair and more black faces than those that have now graduated. The style is a bit more relaxed and the career goals a bit less firm—but the intellectual committment is as firm as it has ever been. There are several distinguishing characteristics of the Class of 1975, but the most remarkable ones are its 124 women—a new record.

Peter H. Richardson, '48, Associate Director of Admissions, says that "we have reached a critical mass of women students this year." After years of pushing out the message that it is a coed school, M.I.T. finally has enough women students to be visible to the outside observer.

Although it was selected from about 20 per cent fewer applicants, the class of 1975 has at least the same level of qualifications as did previous classes. "The numbers are about the same across the board" in test scores and class rank. The class comes slightly better prepared in calculus than its predecessors, as indicated by increased enrollment in the more advanced calculus subjects.

M.I.T. has continued its policy of seeking out the talented but educationally deprived. Although black enrollment is down (from 53 in last year's to 46 in this year's class), the total number of minority-group students is up slightly.

Traditional Values First

Most observers agree that the men and women of '75 are continuing the trend to be more serious about traditional values and ways of doing things. Fewer freshmen are taking advantage of unstructured or self-paced education programs. Enrollment is up in the more traditional humanities options. And the three special education programs (see below) are attracting about the same number of freshmen this year as only two did last year.

Why are this year's freshmen less willing to experiment? Peter Buttner, '61, Assistant Dean for Student Affairs and the man who is most directly involved with the freshman class, feels that the symptoms we observe are not so much symptoms of the particular people admitted in 1971 as of the year itself.

"Everybody is changing—staff and faculty as well. We went through a kind of catharsis of activism here on campus —and it's not clear to me that they didn't go through the same thing in high school."

With 1004 members, the freshman class is slightly larger than average.

. . . and Housing the Class of '75

If the Class of 1975 seemed conventional, its housing certainly did not. There are new dormitories, different styles of fraternities, and—most notable—expanded coeducational living facilities.

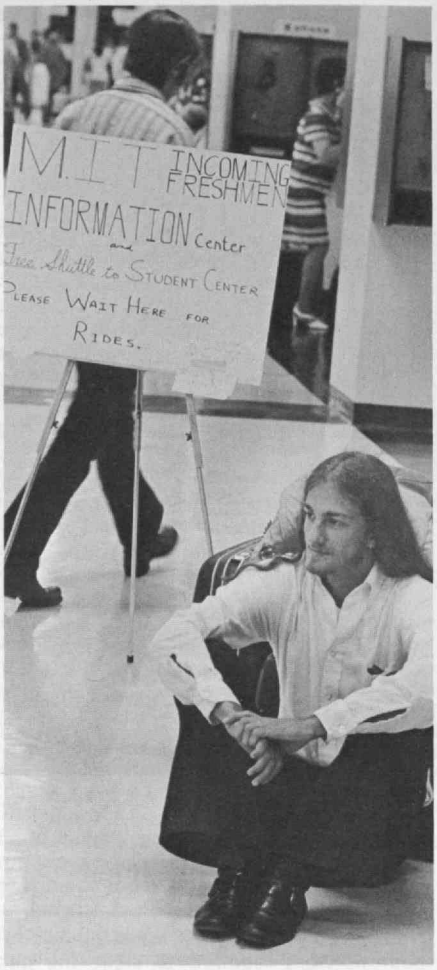
Seventy-five per cent of the freshmen who want to live on the campus were placed in their first-choice dormitories, according to Kenneth C. Browning, '66, Assistant Director of Housing and Dining Services. Predictably, the new dormitories, McGregor House (now beginning its second year) and Burton House (beginning its first year after complete renovation) were the most often requested by freshmen. But Baker House, which was until recently consistently the most popular, scored this year near the bottom of the list.

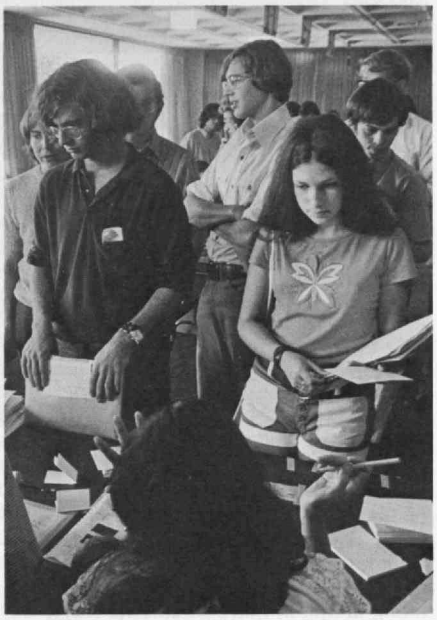
Fraternities had a good year, taking in around 400 freshmen. The newest fraternity, Pi Kappa Alpha, is by now well-established, and Tau Epsilon Phi, which had appeared about to fold, has made a dramatic recovery with the help of its alumni and national office. Two fraternities, Sigma Nu and Delta Psi (No. Six Club), are now coeducational; others have modified or eliminated their pledge training programs.

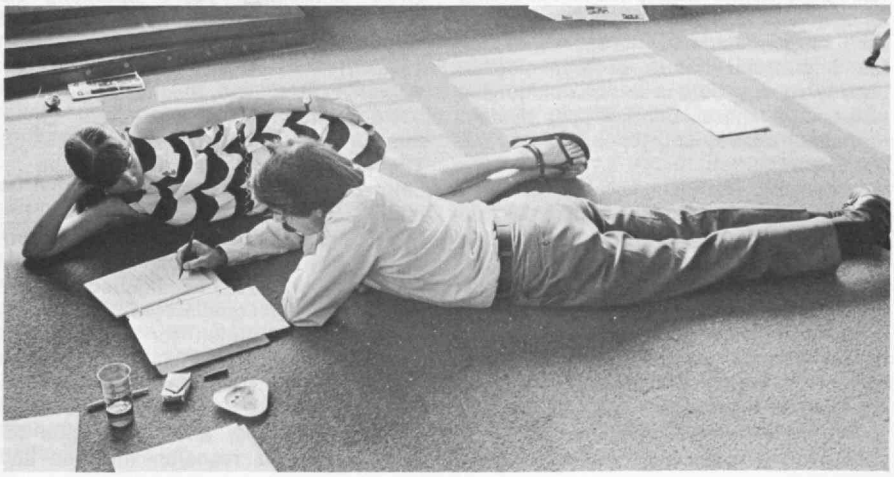
The most drastic change was at Sigma Alpha Mu, where, according to House President Phil Rosenback, '74, the brothers decided last year that they should not have the right to exclude arbitrarily a freshman. They conducted rush week as usual, but asked freshmen interested in joining to sign up and come to a meeting on Sunday night of rush week. A lottery was to have been held at the meeting, but it happened that the number of freshmen wanting to join equalled the number of vacancies in the house. There was no pledge period; the freshmen became members immediately.

Coed living was expended this year to meet the increased demand. There are now about 30 women in East Campus (up from about 15 last year), about 25 in Senior House (up from about 15), 34 in Burton House (which did not exist last year), and two in Russian House (up from zero). There are also about 20 women in three of the independent residences, Student House, Sigma Nu, and Delta Psi. Mr. Browning expects that Burton or McGregor may eventually be integrated on a suite-by-suite basis.

In expanding the coed living programs, M.I.T. has been careful to make sure that McCormick remains full–with the result that not every woman who wants to be in a coed living group can be. Parental reaction to coed living has been mild: there were lots of questions







Though they set statistical records, the Class of 1975—and its welcome to M.I.T.—were otherwise not very unusual. The records are 1,004 members, one of the largest entering classes in the Institute's history, and 124 coeds, surely the largest number of women ever to arrive in a single class. The week beginning September 3 was a period for getting acquainted—with each other, with the Institute, and with a whole new way of living. (Photos: Alfred I. Anderson, '71, Sheldon Lowenthal, '74, and Margaret Foote)

from parents, but most student-parent disputes appear to have been resolved satisfactorily. Mr. Browning concedes, however, that there may be invisible reaction from parents that has not come to M.I.T.'s attention.

Among the women in McCormick Hall who would prefer to be in coed dorms are a few of the 25 Wellesley girls who are at M.I.T. this year as part of a housing exchange program. Only about half of them could be placed in coed dorms. Taking their place at Wellesley are 25 (male) Tech students, who live in segregated floors of Wellesley dormitories, along with students from other predominately male colleges with which Wellesley has established exchanges.

And the exchange is not without educational value—even if what is learned is somewhat unconventional. As one male student was overheard to remark in the corridor one day, "At 8:30 in the morning Wellesley girls look as grubby as Tech tools."

Freshman Options

The Class of 1975 was confronted this September with more academic options than any other freshman class in M.I.T.'s history. Besides a wide range of elective subjects and research activities, there are multiple ways to satisfy every academic requirement and even three special programs which replace completely or in part the regular format for first-year studies. And since there are no grades (just pass or fail), the new class can exercise what President Wiesner called in his welcoming address, "that rare privilege of the freshman—to experiment."

He might have added, ". . . and be experimented on," for the emphasis of many faculty—and students with them—seems to be a search for new ways of stimulating interest in first-year studies by associating with them the excitement of intensive scientific inquiry.

☐ *The Experimental Studies Group* aims to "let students learn as much as possible in ways of their own choosing." E.S.G. students study independently and meet frequently with faculty members to discuss their work. Seminars, concentrated study groups, and individual laboratory projects supplement the independent study. Students may also enroll in one or two regular subjects, but their major effort is expected to be within the E.S.G.

☐ *The Unified Science Study Program* lets students focus their educational activities on projects they formulate themselves. With the help of an advisor chosen from the program faculty, each student develops a written plan telling what he wants to do, how and with whom he will do it, and how his work will be documented and evaluated. Problems which arise in the course of the projects send students off to learn the calculus, physics, or whatever they need to find a solution. The students and faculty meet as a group once a week to discuss the operation of the program.

☐ *Concourse,* a program new in 1971-72, offers a full-time integrated study plan, an "intense and lively interaction of ideas from a great number of different academic fields, with the aim of breaking down the sharp boundaries that often separate the various professional specializations from each other." General meetings focus on a unifying central theme embracing scientific, technical, and humane ideas, while smaller groups of students carry out design or research projects.

☐ *5.01,* the required freshman chemistry subject and for years the ogre of the freshman curriculum, is now but one of five options that satisfy a broadened requirement of either chemistry or biology. The other options are: solid-state chemistry; structure, bonding, and mechanism (in a context of organic chemistry); a subject which concentrates on chemical equilibrium; and, the most popular, an introduction to biology. The basic 5.01 now focuses on electronic structure, spectroscopy, and chemical kinetics.

☐ *Calculus* for freshmen is now designed to accomodate comfortably students with widely varying backgrounds in calculus. The basic sequence can be entered at any of four points. Those who are unhappy with the coverage of the standard sequence can supplement it with related elective subjects. Both the standard sequence and the electives involve a series of pass/fail tests which a student takes whenever he feels ready. He may take a test as many times as necessary before he passes it, but he cannot take a test until he has passed the one before it. Another calculus option offers a more intensive and comprehensive development, taught in more traditional ways.

☐ *Physics* is taught in the standard form; in a more rigorous form; in a form which surveys two years' worth of material in one year; and in a form developed under the auspices of the new Joint M.I.T.-Harvard Program in Health Sciences and Technology which concentrates on topics of physics relevant to biology, biophysics, and biomedical research and engineering. There is also a limited-enrollment section in which students study at their own pace with the help of tutors and special study guides.

☐ *Humanities* is offered in eight different sequences. The basic one, "The Western Tradition," covers the classical and Judeo-Christian worlds in the first semester and the post-Christian, secular world in the second. Each of two other sequences expands half the basic sequence into a full year's study. Others focus on writing as a means of thinking and self-exploration, on contemporary moral issues, on the origin and nature of technological society in America, and on identity and purpose in Black America. Yet another is based almost entirely on Plato, the Bible, and Marx.

In addition, freshmen can choose from among over 150 elective subjects in 23 departments, 36 undergraduate seminars, and three branches of R.O.T.C. They are also presented a 57-page booklet listing opportunities to join research projects for credit. Today's freshmen are let in on the secret—once confined to upperclassmen—that you can get credit for anything you can convince a professor is worthwhile.

And 16 members of this year's freshman class are not even on campus; they have taken advantage of a new "delayed admission" plan which allows them to pursue their own interests away from the campus for a year—without academic credit—before recommencing their formal education.

Graduate Enrollment Down

Enrollment in the Graduate School is down this year—but by much less than had been feared. Dean of the Graduate School Irwin Sizer expects the drop to be from last year's enrollment of 3,300 to about 3,250. This decline compares favorably with the 4.8 per cent national decline in science and engineering graduate students in private universities.

M.I.T. made emergency funds available to partially offset the loss of 150 federal fellowships. New federal policies are shifting the cost of graduate education to the state governments—with the result that public universities, with subsidized tuition, can offer prospective graduate students much better financial situations.

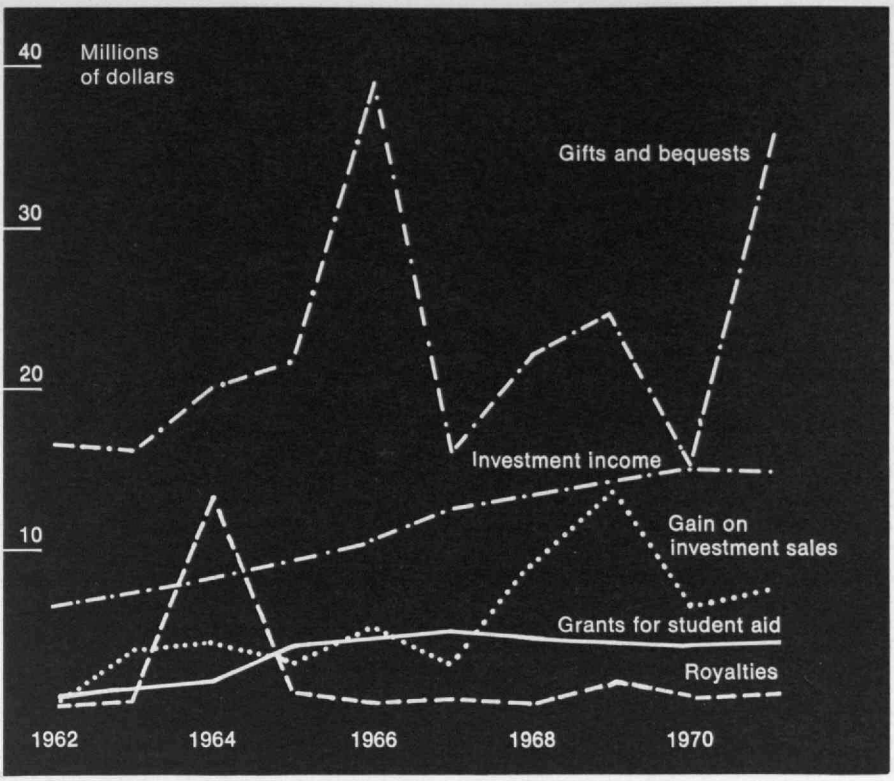
The future of graduate education in private universities in general, and at M.I.T. in particular, is far from clear. And Dean Sizer expects the federal fellowship situation next year to be even worse.

Decreasing Operations, but Higher Drafts on Unrestricted Funds

Nearly $5 million of unrestricted resources were required to close the gap between M.I.T. income and expense in 1970-71, Joseph J. Snyder, '44, Vice President and Treasurer of the Institute, told members of the M.I.T. Corporation in his annual report on October 8; it was the highest use of unrestricted funds in the history of the Institute, comparing with $4.6 million in 1969-70, $2.2 million in 1968-69, and $841,000 in 1967-68.

This invasion of unrestricted resources—"including funds accumulated in earlier years," Mr. Snyder said—along with increased tuition and endowment income and a near-record total of gifts, grants, and bequests, made possible maintenance of the Institute's operations at a level very near that of 1969-70, including a substantial program of student aid, further building construction, and a "large addition" to the endowment capital of M.I.T. The year's operating expenses decreased slightly—from $216.8 million in 1969-70 to $213.9 million in 1970-71.

Gifts, grants, and bequests—totalling, $39.6 million in 1970-71—were higher than in any recent year except 1965-66. The total, Mr. Snyder said, reflected receipt of the remainder of the legacy of Mrs. K. Dexter McCormick ('04); a further distribution from the estate of Leonard D. Lawrence ('29), and the sale of land in Truro, Mass., bequeathed to M.I.T. in 1937 by Dr. Francis H. Williams ('73) to the U.S. government for the Cape Cod National Seashore. Among significant other gifts were support for the Institute's new health science program, endowment for professorships, and major gifts for educational and research facilities and



Though M.I.T. operating expenses fluctuate but little from year to year, its principal sources of funds are subject to wide changes which depend almost entirely on factors outside of the Institute's control. Hence the increasing concern in Cambridge when any year's operating expenses must be met by drawing on unrestricted funds accumulated in prior years—a circumstance which prevailed in 1970-71, according to Joseph J. Snyder, '44, Vice President and Treasurer of the Institute.

At 1:15 a.m. on October 15 M.I.T. telephone operators were warned to "Clear the Harmon Building!" By 1:19 the Boston Record-American *called to warn that its City Desk had been told to expect an explosion at M.I.T. Within five minutes it happened, on the fourth floor of the Grover M. Hermann Building housing the Center for International Studies. Damage to partitions and fixtures (no structural damage) was set at about $35,000, and no one was injured.*

research funding.

M.I.T.'s total endowment funds increased from $190 million in 1969-70 to $216.3 million in 1970-71, due primarily to additions from the estate of Mrs. McCormick. The market value of the Institute's total invested funds, $290.7 million on June 30, 1970, increased to $353 million at the end of the 1970-71 year, due largely to recovery in the market for common stocks and bonds, Mr. Snyder said. Common stocks were approximately half of the general investments and about two-thirds of the endowment investments. The total income on the Institute's investment portfolio—which includes real estate investments yet to be developed into earning assets, Mr. Snyder noted—was $15.5 million.

"Clear the Harmon Building!"

It was an act without a context. Last year, there had been a context: there were scores of telephoned bomb threats, and a bomb had actually exploded in the Harvard Center for International Affairs.

This year, everything had been quiet. No demonstrations, no violence, no threats. The extra security precautions taken in last year's tension had been gradually called off.

But then it happened.

At 1:16 a.m. on October 15 a female voice called the M.I.T. switchboard on an internal line. "Clear the Harmon *[sic]* Building," it said. Only minutes later, before the Campus Patrol could arrive, a bomb exploded on the fourth floor of the Grover M. Hermann Building which houses—among other things—the headquarters of the Center for International Studies, in the past a target of radical demonstrations.

There was no structural damage; the bomb, placed above a false ceiling in a ladies' rest room, blew out doors and interior partitions. M.I.T.'s Physical Plant Department issued a preliminary damage estimate of $35,000. When he made his rounds about midnight a watchman had noticed nothing out of the ordinary; no one was in the building at the time of the explosion, and there was no fire.

State Fire Marshal Ralph Garrett noted the similarity of the bomb to the one at Harvard's C.F.I.A. just 366 days earlier.

While fire marshals and the F.B.I. started sifting through the wreckage, Paul E. Gray, '54, Chancellor, issued a statement: "We are at a loss to explain this wanton and senseless act of destruction." Later President Jerome Wiesner, meeting with students and faculty, said he was most concerned because of the short warning given. Warnings of other bombings in the Boston area have always been sufficient to permit evacuation of affected areas. Asked if he thought M.I.T. students might have been involved, Dr. Wiesner said he "would be very surprised if they were."

Later the *Boston Globe* received a letter, postmarked "PM October 15," from "the Proud Eagle Tribe" claiming responsibility for the bombing. The same signature had appeared on a similar letter after last year's Harvard bombing. The "Tribe," which described itself in the somewhat distraught letters as a group of revolutionary women, said their target was the office of William P. Bundy, Senior Research Associate at the Center for International Studies, and a former adviser to President Lyndon B. Johnson. Mr. Bundy, they said, was "a principle *[sic]* architect of the air war in Vietnam," whose "scenario for escalation culminated in the bombing of North Vietnam in 1965." Mr. Bundy's office was not damaged; neither was Daniel Ellsberg's, also on the fourth floor of the Hermann Building.

The Federal Bureau of Investigation entered the case on its own initiative, M.I.T. announced, under recent federal legisla-

tion empowering the Bureau to investigate the bombing of any institution receiving federal funds.

Arresting the Tuition Curve

In a season when economic problems are high among everyone's preoccupations, one of the "most serious problems" confronting M.I.T. is the impact of inflation on tuition, Jerome B. Wiesner, President, told over 200 members of the Alumni Advisory Council on September 27.

"We are in danger of pricing ourselves out of certain categories of the market," Dr. Wiesner said; and he promised "a major effort to see if we can arrest the rise in the cost of tuition"—limiting it in the future to the general level of inflation in the country as a whole. Hardest hit have been students from middle-income families: tuition is rising faster than typical family income, yet financial aid remains at essentially previous levels.

Supporting Dr. Wiesner, Paul E. Gray, Chancellor, noted that the financial burden on students "is increasing out of all proportion to other prices. The problem of adequate financial aid must be M.I.T.'s number one need," he declared.

Dr. Wiesner told the alumni that he finds M.I.T. "a system that seems to be running pretty well," and his goal in assuming his new duties as President is "to let the clutch in slowly." In addition to the Institute's financial problems—not as serious as in some institutions—Dr. Wiesner reported:

☐ M.I.T.'s new class—larger than recent freshman classes—is "an exciting, interesting, bright bunch of kids." They are seriously preoccupied with academic affairs, in contrast to the preoccupation with political affairs of recent years, Dr. Wiesner said. Indeed, the faculty is worrying that the new freshmen may be "too square." Why the difference? No explanation. But it may be significant that this year's freshmen seem on the average "less committed to any particular career plan than before," Dr. Wiesner noted. Their mood seems to be "to try something and see."

☐ M.I.T. needs to find a better way of developing interdisciplinary research. Many present efforts of this kind, said Dr. Wiesner, "have not taken off as well as we think they should have."

☐ "This is a moment in U.S. history," said Dr. Wiesner, "when it is worth making some pretty strong defenses of science and its future"—a time, he said, when technology is being tested. In doing this we have to be honest: we've made some short-sighted mistakes in our development and uses of new technology. "But this society is not in a position to give up technology; we need only to ask new things of it."

☐ The Institute has a continuing role to play in defense research. Though he has been associated with proposals for limiting U.S. participation in the arms race, Dr. Wiesner assured the alumni that "I do not believe in unilateral disarmament." And no institution should act to subvert national policy on the basis of how strongly its leaders disagree with that policy, he declared.

As the evening opened, Paul V. Keyser, '29, President of the Alumni Association, took time to present Dr. Wiesner with a unique tribute: Honorary Membership in the M.I.T. Alumni Association. But Dr. Wiesner already has one of the principal credentials of such a member: the red coat given him in June, 1971, when he became an Honorary Member of the Class of 1921.

When Jerome B. Wiesner came to the year's first meeting of the Alumni Advisory Council, the usual proceedings were interrupted while Paul V. Keyser, Jr., '29, as President of the Alumni Association, conferred upon M.I.T.'s new President an Honorary Membership in the Association.

Accelerated Management Study

An experimental plan for accelerated study, under which students will work full-time in an intensive summer program and receive the S.M. degree from the Sloan School of Management in 12 months—instead of two nine-month academic years—will be offered beginning on June 5, 1972.

The plan, which represents a substantial innovation in graduate study at M.I.T., simultaneously seeks three goals, according to William F. Pounds, Dean of the School:

☐ Permit accelerated career development, by placing graduates on the job market at the end of 12 months instead of the usual 21.

☐ Ease the increasingly heavy financial burden of graduate study.

☐ Utilize the Sloan School's facilities more fully during the usually quiet summer months.

The accelerated program, particularly that portion given in the summer term, will reflect "exciting developments in curriculum design and teaching methods" stemming from recent efforts by members of the Sloan School faculty, according to Dean Pounds—and he hopes that the new challenge may yield still further improvements in educational programs. The summer program will be "unusually demanding," Dean Pounds said. "Only students having outstanding records of performance and showing evidence of strong motivation will be considered for admission." Only 35 applications will be accepted for the experimental program, and preference will be given to those who have had two to five years of work experience as well as appropriate bachelor's-degree-level preparation.

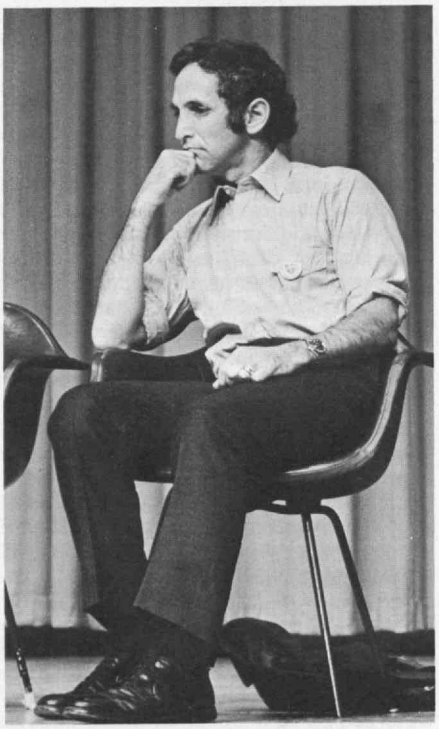
The Invisible "System"

When Daniel Ellsberg, Senior Research Associate in the M.I.T. Center for International Studies, made his first appearance in Boston this fall since he graduated from the role of quiet worker in the vineyard to that of hero in the anti-war movement, he made it into the anti-system movement.

Dr. Ellsberg's "system" is the invisible management of the country—in government, industry, and elsewhere—which is now so powerful that its alienation from the people is nearly complete. Technology is among the system's most important tools, and the Indochinese are among its pathetic victims.

"Many of you are being prepared here at M.I.T. for a place in the system," Dr. Ellsberg told his Kresge Auditorium audience on October 13. "You'll be getting a lot of advice that says, 'Earn good time, retire early.'" But if you follow it, said Dr. Ellsberg, you'll find yourselves in a "career crisis" in 20 years, unable to break out of your role in the system. The difference, he said, is whether or not you resist disciplines based on fear, whether you express your doubts and ask your questions, whether you choose "to make yourselves useful to authority."

Dr. Ellsberg admitted that his advice to distrust authority, to be "skeptical of men in power even if they have been elected to that office," is "ultimately anarchistic and seditious." But he delivered it with restraint appropriate to an intellectual—



Apparently deep in thought, Daniel Ellsberg, Senior Research Associate in M.I.T.'s Center for International Studies, waits to be introduced for his first Institute appearance since he achieved national fame. (Photo: David Townzen, '72, from Technique)

not a militant—revolutionary. And he does not covet for himself the role of hero, said Dr. Ellsberg, though the standing ovation which greeted him (he was introduced by Dr. Salvador E. Luria, Sedgwick Professor of Biology, as a "citizen of a new America") and which was repeated as he finished his hour-long address made it clear that he has assumed that role for many young people. "To do anything else," he said of his decision to release the "Pentagon papers," "was to be part of the system."

M.I.T.'s First Observatory Is Dedicated—and "Sold Out"

George R. Wallace, Jr., '13, left M.I.T. at the faculty's suggestion without a degree, but he and Mrs. Wallace returned on October 15 carrying a warm invitation: they were the guests of honor at the dedication of the Institute's new George R. Wallace, Jr., Astrophysical Observatory in Westford, Mass.

Mr. Wallace's gift of $300,000 (he is retired Chairman of the Fitchburg Paper Co.) made possible the Institute's first optical observatory, a long-awaited, basic tool for a program of teaching and research in astronomy which has flowered since the early 1950's. To the facilities for "exotic" astronomy—radar and radio astronomy—provided by the Institute's Haystack Observatory—just one mile from the Wallace Observatory—and various Lincoln Laboratory radars, there is now added an optical observatory with two modest intruments and a unique control and data-handling system; the combination provides M.I.T. scientists with one of the few optical/radio observatory systems in the world where simultaneous observations of the same celestial object can be made at optical and radio wavelengths.

James R. Killian, Jr., '26, Honorary Chairman of the Corporation, told Mr. Wallace that his gift toward the $500,000 observatory—the balance came from the estate of Mary Louise Waterbury in memory of her husband, Charles D. Waterbury, '95—"in a time when so many things are questioned and when so many people are pessimistic," had given him "a sense of reassurance about the quality of our society."

The 16-inch telescope in the Wallace Observatory, in operation since June, 1971, is principally an instructional instrument, supplementing a larger, 24-inch instrument just now coming into use. By next summer a unique control and data-handling system will be completed to make the Observatory "significantly more efficient and versatile than most existing installations," according to Thomas B. McCord, Associate Professor of Planetary Physics who is Director of the Observatory. Then, writes Peter L. Chu, '75, in *The Tech*, "all one will have to do to observe a celestial object is type its coordinates or even its name into the telescope's computer system, which will point the telescope exactly at the object and automatically keep it there."

Eventually both telescopes—operating singly or in tandem—will be "almost robotic in operation." Then, writes Mr. Chu, "the astronomer would be able to program the telescope system to turn itself on, open the dome doors, look around a section of the sky for a certain star, record its light spectrum, and go on to another star." In this way "the telescope could be made to run through an entire night's observing session automatically."

The Wallace Observatory will not end M.I.T.'s need to use such larger facilities as the Mt. Wilson and Mt. Palomar telescopes, according to Professor McCord. But by providing an instrument on which to test equipment, it will make use of the larger, more expensive machines far more efficient. Interest in astronomy is so great at M.I.T. that already there is inadequate telescope time in the Wallace Observatory for all students who want it. Enrollment in astronomy courses jumped from 22 four years ago to more than 400 last year. New developments have made astronomy an exciting field, and "students have a way of knowing where the excitement is," says Professor McCord.

The excitement of astronomy is not unknown to Mr. Wallace, who included a planetarium—named in honor of Mrs. Wallace—in the $2.4 million George R. Wallace Civic Center for the city of Fitchburg. He has sponsored research on clear-air turbulence and has served for many years as a Director of the Explorers Club and as President of the Explorers Research Corp.

While Mrs. Killian approaches, James R. Killian, Jr., '26, Chairman of the Corporation, welcomes George R. Wallace, Jr., '13, for the ceremonies dedicating the new Wallace Astrophysical Observatory on October 14.

Confronting Northgate

The scene gave one a profound sensation of *deja vu*. Thirty or 40 people, most of them students, surrounded Antony Herrey, S.M.'57, Director of the M.I.T. Real Estate Office, in an unruly question, answer, and name-calling session. They came to charge wrong-doing in M.I.T.'s operation of the Northgate Community Corp., which rents apartments in Cambridge and adjacent communities to M.I.T. affiliates and to other residents.

This year's confrontations with Students for a Democratic Society (S.D.S.) and University Action Group (U.A.G.) were precipitated by the eviction of two families from a Northgate building administered under the federal "leased housing program" by the Cambridge Housing Authority. The eviction was performed by C.H.A. at M.I.T.'s request after a long series of complaints by neighbors. Though S.D.S.-U.A.G. charged racial motives, no one was ever able to demonstrate them.

Then S.D.S.-U.A.G. went on to charge that there was lead-based paint in many Northgate Community Corp. apartments rented to families with small children, and that Northgate was preparing to impose substantial rent increases as soon as wage-price controls permitted. Both turned out to be correct, and the lead paint problem was particularly embarrassing because it was a problem to which Northgate had given little or no thought.

Lead-based paint is found in many old buildings. The danger is to children who may accidentally ingest the lead by eating paint chips which fall to the floor or by chewing on exposed woodwork. M.I.T.'s Environmental Medical Service, which has done pioneering work in assessing the health effects of lead, is now conducting a Northgate investigation, and the Corporation has promised that lead will be removed where necessary.

Northgate was founded to help provide improved housing in Cambridge for both M.I.T.-affiliated tenants and long-time Cambridge residents by putting M.I.T.'s financial and management power behind the purchase, renovation, and operation of real estate. Rapidly climbing costs began catching up with Northgate in 1969-70; then came a rent control ordinance in Cambridge, from which Northgate was granted relief by the courts just as President Nixon's freeze became effective. While rents have now been pushed back to the levels of September, 1969, taxes have climbed 45 per cent, insurance 25 per cent, and heating fuel by various amounts. Northgate, now losing over $18,000 a month, will raise rents by an average of about one-third as soon as the freeze ends.

Diagnosing Management's "Strangulation" and "Confusion"

What is first in the minds of American business executives today?

The popular subject when over 400 of them returned to M.I.T. to renew their classroom experiences on October 10-12 was how to organize a company for effective management: management information systems, organization design and development, corporate strategies, and managing innovation. The "standing-room-only" sign was out for seminar sessions on these topics during the

1971 convocation for former members of the Sloan Fellowship and Senior Executive Programs of M.I.T.'s Sloan School of Management.

How to cope with environmental issues was the second-running subject of the two-day convocation.

Some highlights:

☐ Zenon S. Zannetos, Professor of Management: "Paralysis and strangulation by meaningless data," organizational disarray, cost escalation, and the creation of a "computer cult" are the principal symptoms of crisis in a mangement information system. The accounting system tends to mesmerize us, causing confusion between data and information; data becomes information only when it is placed in an "associative context" by a useful model. No outsider can design an information system for an executive because only the executive has the associative context in which it has to be written. "You have to take the trouble to say what you want," said Professor Zannetos.

☐ Michael S. Scott-Morton, Associate Professor of Management: The vast majority of our computer resources are invested in solving structured problems in operations control. But the vast majority of management problems are unstructured. Changes in computer technology may help to resolve this dilemma, since there has recently been a "remarkable" decrease in the price of computing power. The success of minicomputers, and especially the improvement of low-cost terminals, suggest that it is now possible "to decentralize hardware and place it directly in the hands of users—something which was impossible a few years ago," said Professor Scott-Morton.

☐ Richard A. Carpenter, '64, Chief of the Environmental Policy Division, Congressional Research Service, Library of Congress: Today's environmental programs are characterized by conflict and confusion. We are learning that science and technology do not provide unequivocal answers, that we must make value judgments. President Nixon recognizes this when he asks, "How clean is clean enough?" And the same issue is behind government reversals and public confusion on such problems as the phosphate content of detergents and the side-effects of recycled paper. In the face of this confusion, can we develop an increasingly rational public concern for environmental issues?

☐ Robert B. Semple, '32, Chairman of the Board, BSAT Wyandotte Corp.: Environmental issues have taken on the character of adversary proceedings, and some of our adversaries have discovered that the chemical industry has more answers than expected. But the problems have also taken a major toll of management effort and will require major investments of capital—effects which will surely adversely affect industrial growth and the development of new products and facilities.

How Can We See Our Alternative Futures?

Are there better ways of educating students to work on the increasingly complex problems of urban systems and design?

If the question is trite, it is at least current. For it is the focus of a major effort at self-evaluation and redirection in M.I.T.'s School of Architecture and Planning, led and encouraged by William L. Porter, Ph.D.'69, named the School's new Dean early this fall.

"The key to what we must do," he says, "is make educational settings which couple theory and practice in our various professions." His goals include:

☐ Lowering the intellectual walls between the School's two departments—Architecture, and Urban Studies and Planning—and between the School and the rest of the Institute.

☐ Developing new intellectual foci in small program groups of students and faculty, some discipline-oriented and some project oriented, bridging many professional fields.

☐ Increasing architects' and planners' interest in social and environmental issues to which their work is—or should be—related. The problem today is not to design a more aesthetic or functional building but to identify the people whose needs are truly to be fulfilled and help them organize to understand their needs and advocate them.

Through it all, he says, the School must continue to enhance its students' capacity to envision alternative futures, to understand the institutions which affect urban environments, to understand people as urban inhabitants, to be re-

Some 400 former Sloan Fellows back in Cambridge for their semi-annual reunion-convocation at the Sloan School of Management in October will remember social occasions as well as the Sloan faculty's seminars. Dean Peter P. Gil, who directs the Program as Associate Dean for Teaching Programs, was the official greeter (top).

W. L. Porter

R. L. Walquist

C. A. Campbell, Jr.

G. G. Probst

N. R. Vander Dussen

R. Trachtenberg

sponsive to social problems, and to enhance the quality of life.

Dean Porter, who succeeded Lawrence B. Anderson, M.Arch.'30, upon the latter's retirement, holds degrees (B.A. 1955, B.Arch. 1957) from Yale and has been a member of the M.I.T. faculty since 1968. He maintains a consulting relationship with two Cambridge firms in urban design and programming, and he is a member of the Board of Directors of the Boston Chapter of the American Institute of Architects.

An advocate of using computers to analyze the creative processes and to enhance the ability of architects and urban planners, Dean Porter was largely responsible for the development of the DISCOURSE computer language.

Individuals Noteworthy

To **Karl T. Aust,** Sc.D.'49, the Hofmann Memorial Competition Award of Fourth International Conference on Lead . . . **John S. Jeris,** '53, listed in 1971 Volume: *Outstanding Educators of America* . . . to **William Webster,** S.M.'23, the John Fritz Medal Certificate for 1972 . . . to **George R. Harrison,** Dean Emeritus, School of Science, the William F. Meggers Medal, Optical Society of America and travel fellowship from Australian Academy of Science . . . to **Dietmar Seyferth,** Professor of Chemistry, the 1972 Frederic S. Kipping Award . . . to **Charles S. Draper,** '26, the John Scott Medal . . . to **Kenan E. Sahin,** '63, the Fourth Annual Salgo-Noren Award for excellence in teaching . . . to **Luis A. Ferré,** '24, the 1971 Albert Einstein Commemorative Award in Human Rights . . . to **Jerome B. Wiesner,** M.I.T. President, the 1971 Migel Medal for outstanding service in the field of blindness, from the American Foundation for the Blind . . . to **Norman T. Kridel,** '40, the Distinguished Service Award of the Illuminating Engineering Society . . . to **Joseph K. Lambert,** S.M.'60, the Meritorious Service Medal, U.S.A.F. . . . to **Gordon A. Beals,** '53, the Meritorious Service Medal, U.S.A.F. . . . to **Harry A. Kuljian,** '19, Honorary Doctor of Science Degree.

Frederick Lehmann, '51, to Governor Sargent's Advisory Council on Comprehensive Health Planning . . . **John F. Collins,** M.I.T. Consulting Professor of Urban Affairs, to Board of Trustees of MITRE Corp. . . . **James A. Fay,** S.M.'47, and **Glenn C. Williams,** Sc.D.'42, to Committee for Study of Motor Vehicle Emissions, National Research Council . . . **John H. Austin,** S.M.'53, to Chairman of South Carolina's Environmental Health Task Force . . . **Julius Adams Stratton,** '23, to Trustee of Museum of Science and Chairman of its Education Committee . . . **Robert Alberty,** Dean of School of Science, to Chairman, National Research Council, Division of Mathematical Sciences.

C. A. Campbell, '59, to President and Chief Executive Officer, Goodman Equipment Corp. . . . **Norman R. Klivans,** '40, to Vice President, Auctor Associates, Inc. . . . **William R. Prindle,** Sc.D.'55, to Director of Research and Vice President, American Optical Corp. . . . **Frederick W. Gander, Jr.,** '65, to Director of Economic Research, Associated Industries of Massachusetts . . . **Robert A. Weinerman,** S.M.'48, to Trustee of Society for Savings . . . **Benjamin Kessel,** S.M.'48, to Vermont Research Board of Directors . . . **Charles H. Ehlers,** '52, to Executive Vice President, Dewey and Almy Chemical Division of W. R. Grace and Co. . . . **Robert B. Nickerson,** '51, to General Manager, States Co. of Hartford . . . **David S. Crimmins,** Sc.D.'64, to Manager of Manufacturing and Product Development, Smith Kline and French Laboratories . . . **Joseph M. Engel,** '37, to Assistant Chief Metallurgist, Republic Steel Corp. . . . **Alexander d'Arbeloff,** '49, to President and Chief Executive, Teradyne Inc. . . . **Neil R. Vander Dussen** S.M.'70, Division Vice President, Broadcast Systems, R.C.A. Communications Systems Division . . . **Charles E. Reed,** Sc.D'37, to Senior Vice President, General Electric . . . **Robert Trachtenberg,** S.M.'54, to Manager, Technical Planning, R.C.A. Government and Commercial Systems . . . **Lincoln A. Divoll,** S.M.'59, to Board of Directors, Rhode Island Hospital Trust National Bank . . . **William P. Thomson,** S.M.'52, to Area Manager—Far East and Managing Director of Amoco Japan Oil Co. . . . **Robert L. Walquist,** S.M.'51, to Vice President, T.R.W. Systems' group . . . **John R. Green, Jr.,** S.M.'66, to Vice President, Operations for North American Rockwell's Automotive Products Division . . . **Gerald G. Probst,** S.M.'56, to Sperry Rand Corp., President, Univac Division . . . **Alan Kotliar,** '57, to President and Chief Executive Officer, McFarlane Gendron Manufacturing Co. Ltd. . . . **Richard J. Hamlin,** S.M.'56, to Vice President, Computer Business Management Corp. . . . **M. B. Harrington, Jr.,** '45, to Marketing Manager East, Shell Oil Co., Central Marketing Region . . . **Charles G. Fletcher,** '52, to President and General Manager, Jerguson Gage and Valve Co. . . . **Kenneth A. Marshall,** '47, to President, Health Industries Association.

William R. Hewlett, S.M.'36; **Salvador E. Luria,** M.I.T. Professor of Biology; **Robert W. Mann,** '50, M.I.T. Professor of Mechanical Engineering; **Nevin S. Scrimshaw,** M.I.T. Professor and Head of Department of Nutrition and Food Science; **Walter A. Rosenblith,** M.I.T. Provost to Institute of Medicine, National Academy of Sciences . . . **Nathan E. Promisel,** '29, to President-Elect, 1971-72, American Society for Metals.

Harvey S. Picker, '63, to Assistant Professor, Trinity College . . . **John H. Linebarger,** S.M.'61, to Associate Professor, Mechanical Engineering, Western New England College . . . **Walter W. Soroka,** '30, to Dean, Continuing Studies, University of California at Berkeley . . .

Alumni Calendar

Atlanta—December 6, Monday, 12:15 p.m.—Luncheon meeting, Riviera Motel.

Boston—December 9, Thursday, 12:15 p.m.—Luncheon meeting, Aquarium Restaurant. Speaker: J. Herbert Holloman, '40. Topic: "Technology and Society: America's Dilemma."

—January 13, Thursday, 12:15 p.m.—Luncheon meeting, Aquarium Restaurant. Speaker: Alan Altshuler, Secretary of Transportation, Commonwealth of Massachusetts. Topic: "The Future of Mass Transportation."

Columbus—December 8, Wednesday, 12:15 p.m.—Luncheon meeting, University Club.

Los Angeles—December 9, Thursday, 6:30 p.m.—Dinner meeting, place to be announced. Speaker: Dr. Paul E. Gray, '54, Chancellor of M.I.T.

Mexico City—March 16—18, 1972 the Twenty-Fourth Annual M.I.T. Fiesta.

Northern New Jersey—December 3, Friday, 6:30 p.m.—Dinner meeting, Neptune Inn, Paramus. Speaker: Congressman William B. Widnall. Topic: "The Role of Federal Government in Higher Education."

Philadelphia—January 22, Saturday, 6:00 p.m.—Dinner meeting honoring Dr. Paul E. Gray, '54, M.I.T. Chancellor, Union League of Philadelphia.

San Francisco—December 8, Wednesday, 6:30 p.m.—Dinner meeting, Place to be announced. Speaker: Dr. Paul E. Gray, '54.

Deceased

Charles G. Hyde, '96, September 21, 1971
John A. Ross, Jr., '01, September 17, 1971
Harold D. Larrabee, '02, September 21, 1971*
James P. Barnes, '05, January 15, 1968
Alfred B. Babcock, '08, June 4, 1971
Harry S. Chandler, '08, September 16, 1971*
Everett H. Newhall, '08, September 15, 1969*
George E. Wallis, '09, September 12, 1971
Erford M. Potter, '10, August 10, 1971
James F. Duffy, '11, September 20, 1971*
David Follett, Jr., '12, July 25, 1971*

Jack Lehaerts, '12, September 18, 1971*
John M. Pettingell, '12, October 8, 1971*
John E. W. Giffels, '14, May 12, 1971*
Edwin B. Goodell, Jr., '15, September 16, 1971
Ira S. Lewis, '15, 1965
William H. Smith, '15, August 21, 1971*
Osborne L. Mahlman, '16, July 19, 1971*
N. Julien Thompson, '16, September 25, 1971
Morris M. Brandegee, '17, June 16, 1971
Daunis E. Braud, '17, October, 1970
Frederick G. Crisp, '17, December 9, 1970
Donald S. Kendall, '17, December 5, 1970
Harold J. Quilhot, '17, July 14, 1971
Norman R. Hamilton, '18, January 1971
Marshall B. Lee, '19, August 5, 1971
Leon H. A. Weaver, '19, August 1, 1971
Henri P. Junod, '21, October 6, 1971
Raymond A. St. Laurent, '21, September 4, 1971*
Hugh F. Peirson, '21, June 21, 1971
Jonathan Chace, '22, September 7, 1971
William A. Clark, 2nd, '22, October 18, 1970
Donald R. Goodnow, '22, June 28, 1969
James A. McDonald, '22, July 17, 1970
Henry R. Haines, '22, May 14, 1971
Paul E. Lord, '22, October 16, 1970
Daniel P. Moynihan, '22, August 1, 1971
Floyd J. Wilson, '22, August 28, 1971
George A. Johnson, '23, October 9, 1971*
George K. Shands, '23, March 5, 1971
Chester C. Taylor, '23, September 13, 1971*
Erwin G. Schoeffel, '23, June 13, 1971
Charles M. Cooper, '25, August 12, 1971
Julien J. Edgerly, '25, July 26, 1971
Joseph P. McCarthy, '25, July 4, 1971
Joseph J. Terrell, '25, June 27, 1971
Nelson O. Clark, '27, July 30, 1971*
Merrell R. Fenske, '28, September 28, 1971
Charles E. H. Hemminger, '28, July 19, 1971
Edward B. Farmer, '29, August 29, 1971*
George F. Crotty, Jr., '29, July 1, 1971
Peter S. Kallelis, '30, July 19, 1971
Samuel G. Ryan, '31, June 13, 1971
Marshall P. Wilder, '33, June 1967
Frederick L. Stephens, '35, June 15, 1971
Frank R. Berman, '36, June 13, 1971
H. Dudley Swain, '37, September 8, 1971
Bradley L. Newcomb, '40, August 2, 1971*
Joseph A. McGinniss, '40, September 8, 1971
Leonard E. Pawlowski, '40, June 27, 1971*
Kenneth P. Seltzer, '41, June 22, 1971
Stanley M. Smolensky, '41, October 5, 1971
David L. Arenberg, '42, September 18, 1971
Robert L. Lichten, '43, September, 18, 1971*
Phyllis U. Kessel, '44, October 2, 1971
Arthur W. Erion, '46, July 16, 1971
Benjamin Kessel, '48, October 2, 1971
Leonard P. Salter, '48, September 1965
Morris L. Waters, '50, August 23, 1971*
Paul F. Cotter, '57, August 14, 1971
Yves A. Breton, '58, September 23, 1969
Otis C. Myers, Jr., '58, August 30, 1971
Donald W. Richards, '60, September 16, 1971
Jack E. Charipar, '62, August 18, 1971
Byron C. Burnett, '70, June 13, 1971
*Further information in Class Review

Brewer Engineering Laboratories Inc.

Consulting Engineers
Experimental Stress Analysis, Theoretical Stress Analysis, Vibration Testing and Analysis, Specialized Electro-Mechanical Load Cells and Systems, Structural Model Testing and Fabrication, Strain Gage Conditioning and Monitoring Equipment.
G.A. Brewer '38,
Marion, Massachusetts 02738
(617) 748-0103

Capitol Engineering Corporation

Consulting Civil Engineers

Robert E. Smith '41,
Edward W. Boggs '56

Dillsburg, Pennsylvania 17019

Cleverdon, Varney and Pike

Consulting Engineers

Structural, Electrical, Civil, Heating and Ventilating, Air Conditioning, Plumbing

112 Shawmut Ave.
Boston, Massachusetts
02118

Charles Nelson Debes Associates, Inc.

Engineers and Consultants
Structural, Electrical, Mechanical, Acoustical, Industrial, Commercial and Municipal Projects
C.N. Debes '35
915 East State Street
Rockford, Illinois

Fay, Spofford & Thorndike, Inc.

Engineering for Government and Industry

Ralph W. Horne '10, Howard J. Williams '20, William L. Hyland '22, Edward C. Keane '22, William J. Hallahan '32, Fozi M. Cahaly '33, George M. Reece '39, Max D. Sorota '50

11 Beacon Street, Boston, Mass.
02108

Haley & Aldrich, Inc.

Consulting Soil Engineers

Foundation Systems Engineering Engineering Geology—Seismic Surveys Site Evaluation & Development Consultation for Design & Construction Earth Dam Design
H. P. Aldrich, Jr. '47 D. E. Reed '64
M. C. Murphy '51 J. J. Rixner '67
W. H. McTigue '54 E. B. Kinner '70
238 Main Street, Cambridge,
Massachusetts 02142

The Ben Holt Co.

Engineers and Constructors
Planning and Feasibility Studies
Design and construction of facilities for the Energy Industries
Ben Holt, '37
R. E. Hodgson, '51
D. H. Cortez, '68
521 East Green Street
Pasadena, California 91101
(213) 684-2541

Kuljian

Engineers·Constructors
Utility-Industrial-Public Works Power Plants (Nuclear·Fossil·Hydro), Transmission Systems (HV & EHV), Industrial & Processing Plants, Highways & Expressways, Airports & Facilities, Government & Institutional Buildings, Military Installations
H.A. Kuljian '19, A.H. Kuljian '48

1845 Walnut Street, Philadelphia, Pa. 19103. Tel.: (215) 561-5300

Harold A. McCrensky Associates, Inc.

Management Consultants

Work Standards; Incentive Plans; Management Controls; Standard Costs

H. A. McCrensky '38, President
J. L. Gould HBS'37, Vice President
G. Beesley '39, Vice President
H. E. Jans '52, Senior Consultant

Park Square Building
31 St. James Avenue
Boston, Mass. 02116
Telephone: 617-542-2640

Mueser, Rutledge, Wentworth & Johnston

Consulting Engineers

Foundations for Buildings, Bridges and Dams-Tunnels-Bulkheads-Marine Structures-Soil Studies and Tests-Reports, Design and Supervision

William H. Mueser '22,
Philip C. Rutledge '33

415 Madison Avenue
New York, New York 10017

Polysciences, Inc.

Research, Development, and Consultation in the Fields of Polymers, Monomers, Life Sciences, and Medical Plastics.

B. David Halpern '43

Paul Valley
Industrial Park
Warrington, Pa.
(North of Philadelphia)
(215) 343-6484

Maurice A. Reidy Engineers

Foundations and Soil Mechanics
Structural Designs, Buildings, Bridges
101 Tremont Street
Boston, Massachusetts 02108

Stearns & Wheler

Civil and Sanitary Engineers
Consulting Engineers
Sewerage Drainage and Flood Control, Water Supply and Distribution, Water and Waste Treatment, Municipal Engineering, Refuse Disposal, Fire Protection, Airports
W.O. Lynch '47, S.G. Brisbin, '50
A.G. Wheler '51, J.S. Grumbling '55
10 Albany Street, Cazenovia, New York 13035 (315) 655-8161

Alan Wofsy & Associates

Creative land development in San Francisco and Northern California

Alan Wofsy, MCP '67
1197 Cragmont Ave.
Berkeley, California 94708

(415) 843-9316

Class Review

95

When this is read by you I will have celebrated my 98th birthday on October 16. Hard to believe!

My legs are not as good as they were, so I am not able to take my daily walks! My doctors think I am unusual so I don't dispute them, knowing what excellent care they give me.

My family encourages me and keeps me striving. Best wishes to all.—**Andrew D. Fuller,** Secretary, 1284 Beacon St., Brookline, Mass. 02146

96

Birthday congratulations were extended to Dr. **William D. Coolidge** who was 98 on October 20. Columbus Day weekend your Secretary stopped in Schenectady, (en route to Boston from Washington, D.C.) and found Dr. Will finishing his chores of raking up the fallen leaves in the yard. He reported that he had had a good summer as he had spent much time at his camp with various members of the family. His son and his wife had come early in June because he had a business engagement in the East, and later on grandson, William and his twin sister, Pat, had driven from Colorado.

Daughter Elizabeth and her husband came from Oregon in August and her daughter and family came from Palo Alto. Three great-granddaughters enlivened the scene for Dr. Coolidge. Still another granddaughter and her husband visited from Ontario. When Kathy Coolidge Huber came from Washington she brought along the newest twig on the family tree—and the first great-grandson.

In addition to the staggered visits from all members of his own family, there was another visitor of note. One day a black bear came to call—and stayed long enough to be photographed! The Coolidges have had their camp for many years and this was the first time anyone had seen a bear there!

Fall roses and chrysanthemums are at their height in the D.C. parks as this is written, but by the time it is in print it will be near the holidays. May all of you enjoy your friends and family this Christmas season.—**Clare Driscoll,** Acting Secretary, 2032 Belmont Rd. N.W. #612, Washington, D.C. 20009

98

As this is the issue of the *Technology Review* just prior to Christmas 1971, we wish the members of '98 and their relatives a very Merry Christmas and a New Year filled with good health.

There were two birthdays last month. We hope that **Bob Lacy** and **Joe Riley** had a happy day. They were born in 1876 eight days apart, November 13 and 21.

Your secretary is trailering again in the south with Harold, following the sun and seeing places new to us.—**Mrs. Audrey Jones Jones,** Acting Secretary, 232 Fountain St., Springfield, Mass. 01108

02

We quote from a clipping from the *Hartford Courant* received through the kindness of Dick Feingold, Secretary of the Class of 1943. "Windham, **Harold D. Larrabee,** 91, former Connecticut Light and Power Co. (C.L. and P.) officer died at his home on Route 14, Tuesday, September 21. He was born in Bath, Maine. He was graduated from M.I.T. in 1902 and was employed as manager of the Connecticut Light and Power Co. in Montpelier, Vt., until 1919 when he came to Norwich as assistant general superintendent of operations for the C.L. and P.

"In 1937 he was appointed eastern division manager of C.L. and P. and was stationed in Willimantic. He retired in 1945. While in Norwich he was active in civic affairs. He was a past president of Norwich Rotary Club, past president of the Norwich Chamber of Commerce, and past president of eastern Connecticut Council of Boy Scouts from which he was given the Silver Beaver Award in 1934 for distinguished service to boyhood. He was a member of the Windham Congregational Church and a life member of the American Institute of Electrical Engineers. He leaves his wife, Mrs. Mary Putney Larrabee; a daughter, Mrs. Clifford Hamil of Windham; three grandchildren and five great-grandchildren."—**Burton C. Philbrick,** Secretary, Greycroft Inn, 68 Dane St., Beverly, Mass. 01915

03

Your Secretary represented the 1903 Classmates at the Inauguration of Dr. Jerome J. Wiesner as thirteenth President of M.I.T. on October 7 in Rockwell Cage. The occasion was fully attended by our alumni and particularly by the undergraduates as this event will become an historic memory in later M.I.T. reunions. More than 4,000 members of the M.I.T. community, faculty and staff enjoyed the music of the M.I.T. Concert Band and Brass Ensemble. Addresses followed by three former M.I.T. presidents—Drs. Killian, Stratton and Johnson, concluding with the transfer of the M.I.T. charter to Dr. Wiesner. The new president gave a stirring speech with his future plans for M.I.T.'s continued leadership in science and world influence.

An attractive and appropriate feature for the occasion was the pictorial presentation of the first half of the 110-year history of M.I.T. This was displayed under glass on the corridor walls of Hayden Gallery. The exhibition was aptly timed by the Department of Humanities in connection with the Inauguration of Dr. Wiesner. Our classmates would be thrilled to see photographs of the early presidents of M.I.T. —Rogers, Walker and Pritchard, whom we saw frequently about the spacious facade of historic Rogers. The photographs of the old laboratories—chemistry, physics, biology and mining—in Boston, displayed our small quarters of action. Yet they helped us fulfill our fondest desires to later succeed in each engineering field. We look back from our retirement with gratitude. There was also a photograph taken of the annual alumni outing at Nahant in 1909, showing our '03 members with their broad-rimmed hats and class numerals seated in front of the Relay House along with other classes. Our '03 class was doomed to the background, however, until Gil Gleason acted. He was a member of the '03 football and track team, the Grand Duke in the college play "Medicine Man", and Assistant Class Secretary under Chester Aldrich from 1923 to 1926. Gil became alert and equal to the dilemma. He at once cleverly and with mathematical precision, broke the line of formation of the other classes. Accordingly this provided the central foreground of the photo for our '03 classmates to be displayed more prominently for future posterity.

Good wishes to all '03 classmates.—**John J. A. Nolan,** Secretary-Treasurer, 13 Linden Ave., Somerville, Mass. 02143

G. Tower, '05

04

In my last report I mentioned getting a short note from **Fred M. Pierce.** Since then I received a letter from an old friend of his, Chester R. Shaw, '05, who writes as follows.

"Recently I visited with Fred M. Pierce, 1904 at Yarmouthport on Cape Cod. Fred has been a resident of St. Petersburg, Fla., for many years, and had a summer home on Cape Cod until his wife, Louise, passed on a few years ago. He is spending this summer with his daughter in Worcester, Mass. Fred is in good health and as alert as ever. However, that thick dark wavy hair of his is all gone! He and I were boyhood friends and we enjoyed talking about, and looking at pictures of the 'old gang'. His plans for the coming winter are not yet determined."

I received a post card from **George Kaiser** which reads as follows: "Athens is a beautiful clean city with broad avenues, modern buildings, considerable traffic. Old quarters with narrow streets, several parks. The Acropolis is located on a hill about 500 feet high, a mile from our hotel. Our taxi took us about half way up. We climbed the rest of the way. The going was rather rough. G. K. Kaiser." Thanks for keeping us informed George. . . . Holiday Greetings and best wishes to you all.—**Eugene H. Russell,** Secretary, 82 Stevens Road, Needham, Mass.

05

If it hadn't been for a last minute air mail letter from our assistant secretary, **Bill Ball,** this issue, as far as '05 is concerned, would be a blank. Here's what saved my reputation.

"Your Assistant Secretary and his wife Peggy took off from their Florida home and headed north to New York on July 24. The flight from Sarasota-Bradenton airport took only two hours and ten minutes. Bill, Jr., '34, loaned us a car for the balance of our 'Safari' which included Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, and New Jersey. Peggy made a side trip to Nova Scotia. While in Maine, we stayed at the Islesboro Inn on Islesboro Island in Penobscot Bay. As a bonus, President Nixon and family stayed over the weekend at the home of Jack Dreyfus on Little Minot's Island about three miles from our Inn as the crow flies. It was very interesting to watch the entourage of press representatives, security guards, telephone and photo wire service men, Coast Guard boats, helicopters, planes, etc. in action. Many of the press stayed at the Inn and several knew my granddaughter, Nancy Ball, who, as a reporter for *Newsweek* sometimes accompanies the Nixon party as they go back and forth to their Florida and California homes. She was among the press who accompanied Mrs. Nixon to Peru after the big earthquake.

"Ray Ellis '22, whose summer home is in Islesboro, gave us a big thrill by sailing around Minot's Island in his cabin cruiser. We had a fine view of the big white Dreyfus house and lovely grounds all under the scrutiny of a Coast Guard boat. We saw the President as he sailed by the Inn twice and waved.

"Besides visiting relatives and friends, we visited Ruth and Fred Goldthwait and enjoyed one of Ruth's delicious dinners, complete with fresh blueberry muffins! It was so good to see them. We spent a week on Martha's Vineyard among the long-haired boys—a few of whom really looked like they had bathed recently. The Island was much too crowded for comfort. We chose to remember it as it was years ago when we frequently stayed there. Stopped at Wood's Hole to see my old 'cronie' **Prince Crowell,** the seafaring century plant, who still chases Father Neptune around in his racing sailboat. Here was another happy reunion of two old 'salts.' We were sorry to see Ethel quite crippled but with no thought of giving in to her misfortune. We look forward to seeing them in Florida this winter."

Now that you realize my situation in gathering news, perhaps someone else will send me another air mail letter. Please do not wait until the last minute, though.

Most of you will recognize the picture herewith. **Gib Tower** is the youngest member of our class, and is still active in his work as a member of the planning board of his home town, Cohasset, Mass.

I have just learned of the death of **Jim Barnes** on January 15, 1968. Ever since I learned of his move to Chicago, I have been trying to get a word from him. More detail later, if possible.—**Fred W. Goldthwait,** Secretary, Box 231, Center Sandwich, N.H. 03227; **William G. Ball,** Assistant Secretary, 6311 Fordham Place, Bradenton, Fla. 33505

06

It won't be long now before you might see the team of reindeer and that jolly red-cheeked fellow floating by in the evening sky. That special day is coming and Marion and I send our best wishes for a Happy Christmas and a rewarding, enjoyable New Year.—**Edward B. Rowe,** Secretary, 11 Cushing Rd., Wellesley Hills, Mass. 02181

07

The mailbag only produced two news notes this month, both via Alumni Fund envelope flaps. **Roland H. Willcomb** writes, "We are still enjoying our hideway on the Hood Canal with its beach replete with oysters and clams and its upland woods abounding with wildlife, animal and vegetable. We have endeavored to keep our 12 acres in natural ecological balance much to the enthusiastic approval of our friends. After successfully combatting a case of shingles and a later case of bronchial flu, I'm back at my usual pursuits."

James E. Garratt sends along the happy news that he's "still alive and in business as actively as possible at 85-plus!"

And that's it for news this month; the mailbag is empty. Please help to fill it up by sending in your news. Happy Holiday to all.—Kathy Sayre, Class Notes Editor, Technology Review, M.I.T., Room E19-430, Cambridge, Mass. 02139

08

We have received a letter from our classmate **Miles Sampson** of 925 New Boston Rd., Fall River, Mass. His work has been almost completely in textiles, including machinery, buildings, production and finishing. He has worked in Pawtucket, R.I., Manchester, N.H., Clark Mills, N.Y., Fall River and Dighton, Mass. All these firms except the last two are long out of business or moved south.

In 1910 he married Myra A. Bates of Whitman, Mass. They spent a number of winters in St. Petersburg, Fla., until 1966, when his wife became crippled with arthritis and they had to return to Fall River. He retired in 1956. Miles is well after three major operations following a broken back. They have both been active in the First Baptist Church and he has been in Masonry (inactively) for more than fifty years.

We are sorry to report the passing of another classmate **Harry Stuart Chandler** who died September 16, 1971. He was born in Somerville, Mass., January 1, 1886. He was associated with du Pont Co. in New England until 1929 when he went to Toronto and Montreal. Since retiring in 1951, he spent his summers with his family at Manomet Point, Mass. He leaves his wife Mildred, eleven grandchildren and three great-grandchildren.

We regret the passing of another member of our class **Everett H. Newhall** of 142 Locust St., Danvers, Mass., who died September 15, 1969. He graduated from M.I.T. with an S.B. in chemical engineering. He lived with his daughter-in-law' Mrs. Darling at the above address. . . . There are only two changes of address: George A. Abbott, 525 West Laramic L.A., Milwaukee, Wisc.; Mrs. Harry C. Lord, 1651 20th Ave. North, St. Petersburg, Fla.—**Joseph W. Wattles,** Secretary, 26 Bullard Rd., Weston, Mass. 02193

09

The Class was represented at the Inauguration of President Jerome B. Wiesner by your secretary and by **Tom Desmond,** Life Member of the Corporation, on Thursday, October 7. In the morning there was a panel discussion in Kresge Auditorium on the directions of research at M.I.T. under the chairmanship of Pro-

vost Walter A. Rosenblith. Later, as at the June Homecoming, the editors of the *Technology Review* met with the class secretaries in the penthouse in West McCormick Hall, the very place in which the class held its sixtieth reunion. We all remember the pleasant surroundings and the magnificent 360-degree view of Cambridge, Boston, and environs with the harbor in the distance. We again met Kathy Sayre who now edits our class notes, Brenda Kelley, our former editor who has become Associate Editor, and John Mattill, the editor who has done so much to improve the format of the *Review* and to expand its coverage. At noon we attended the luncheon in the Student Center where we had the pleasure of meeting other class secretaries and alumni. In the afternoon there was a panel discussion on education at M.I.T. Later the Inaugural ceremony was held in Rockwell Cage with music by two M.I.T. bands. There were remarks by Dr. Killian and a poem dedicated to Dr. Wiesner written and read by Archibald MacLeish. The investiture followed with the inaugural address by President Wiesner. A more complete description of the occasion will be found elsewhere in this *Review. (See pp. 81-85.)*

We are pleased to report that we have received another of Alice Desmond's books, *Cleopatra's Children* with the compliments of Tom and Alice. This is another of her several biographies of outstanding historical characters. We have read the book and it is so interesting that we found it difficult to lay aside until we had finished it. The book embraces that important era of Roman history which includes the reigns of Julius Caesar, Mark Antony, and successive emperors through Nero, the last of the Caesars. Cleopatra is generally thought of as a glamorous woman who enticed the two Roman emperors but Alice shows her extraordinarily high capabilities as queen and ruler of Egypt, building Egypt into a strong, wealthy country envied by Rome.

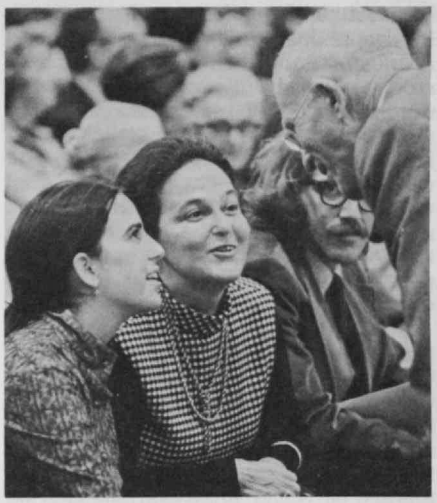
It becomes most unpleasant to report the deaths of two more prominent classmates. We received a note from Mrs. Albert W. Dodge, daughter of **George Wallis,** telling of his death on September 12 and enclosing an obituary from the *Wenham* (Mass.) *Times.* She stated that he had been in poor health for some time and his activity had become increasingly limited during the past years. We wrote immediately to Mrs. Dodge expressing the sympathy of the class as well as our own, and in behalf of the class sent a gift to the First Church in Wenham in his memory. We received the following reply: "My sister and I very much appreciate your expression of sympathy and the gift of the Class of 1909 to the First Church in Wenham in memory of our father. In addition to the information in the newspaper clipping, I might add that my father grew up in Beverly and his family had lived there for many generations. The house in Wenham in which he had recently lived for so long had been in my mother's family for many years. As you have said, Dad enjoyed an active life with a very keen interest in golf until his ill health of the past two years." George graduated in Course II, was assistant secretary and a most active member of the class. He and Marcia attended regularly our Alumni Day and Class reunions. He was an excellent golfer and continued playing as long as his health permitted. After graduation he taught at the University of Michigan for two years. He then began work with the Creamery Package Company at Boston and Chicago and rose to the positions of general manager and president, and ultimately to chairman of the board until he retired in 1952. He told your secretary that the company owned several factories located in different parts of the country and it took much of his time and effort visiting them. He was a former president of the Dairy Industries Supply Association, past treasurer and director of the National Dairy Council, member of the American Society of Refrigerating Engineers, a member of the Union League Club of Chicago, of Liberty Lodge A.F. and A.M., and the Curious Artificers of Wenham, and a former member of the Salem Country Club. For a number of years he and Marcia spent their winters in Florida. She passed away in 1969. He is survived by two daughters, (Elizabeth) Mrs. Albert W. Dodge of Wenham and (Frances) Mrs. Addison L. Sandford of Wayland, five grandchildren, six great-grandchildren and one niece. We have lost a classmate who attained prominence in business and the community and contributed much to the class and M.I.T.

We also received a notice of the death on August 2 of **Edward L. Ryerson,** whose home was Lake Forest, near Chicago. He prepared for college at the Hill School, attended Yale University, and graduated from M.I.T. in Course I. Ed joined the family steel business (Jos. T. Ryerson and Sons) which is well known throughout the country, and later the Inland Steel Company. His headquarters were in Chicago where he made many contributions to civic and community affairs. George Wallis, whose headquarters were also in Chicago, knew Edward quite well and contacted him for any M.I.T. news items. We have written to Mrs. Ryerson expressing the sympathy of the class.— **Chester L. Dawes,** Secretary, Pierce Hall, Harvard University, Cambridge, Mass. 02138

11

The following is from the *Washington Post* of June 29, 1971: **Charles Phillips Kerr,** 82, a retired engineer, died Sunday at Fairfax Hospital. A native of Chicago, Mr. Kerr was a graduate of the Massachusetts Institute of Technology. He served in the army during World Wars I and II and with postwar occupation forces in the Far East. In 1948 he retired from the army with the rank of colonel.

Mr. Kerr worked as an engineer for private firms and for several government agencies including the State Department and the Office of Defense Mobilization and the Munitions Board. At the time of his retirement in 1958 he was working on campus planning for the Maryland State Department of Education. Mr. Kerr lived



Tom Desmond, '09, stops to chat with Mrs. Wiesner and daughter Lisa at the Inaugural Concert.

at 7717 Jansen Dr., Springfield, Va. He is survived by his wife, Isabel, three daughters and a son.

It was some time after I sent in the notes for the October-November issue that I received word from his family that **James J. Duffy** died in Marrakesh, Morocco on September 20. Jim enjoyed traveling and at the time of his death was on tour in Africa. Jim and I grew up not far apart in Dorchester but I did not meet him until we entered the Mechanic Arts High School. In the years since I have come to admire him as a fine gentleman as well as a brilliant businessman. After graduating in electrical engineering, he moved to Chicago where he was admitted to the Illinois bar and qualified as a certified public accountant. He was a very successful business consultant and auditor. Jim has been faithful in attending our five-year reunions and for the past several has written the log of doings that appeared in the Eleveners and this year in last month's Notes. Several years ago Jim was appointed Estate Secretary for the Class. If I only had Jim's ability these notes would be much more interesting and better written. At the reunion last June, Jim promised to send me the story of his life for the notes after he returned from his Africa trip. We are all the losers by his untimely passing.

A late note: Isabel Kerr passed away on July 29, one month after her husband. . . . Here are two address changes: Professor William I. MacCreadie, 410 21st St., Box 67, Lewisburg, Pa. and Stanley H. Lawton, 268 Summer St., Boston, Mass, 02210.

Some notes about those who did not attend the reunion: **Marshall Comstock** was at his summer place in Maine; he drives very little and not at all at night and didn't feel able to make the trip but was with us in spirit. . . . A fine long letter from **Edward Suess** said he was away when the applications for rooms at the reunion came and when he got them he thought it was too late. He was very sorry and is planning a trip to Boston where he has not visited in many years. Last year he went to Alaska and the year before to Europe. . . . **Harry Tisdale** is

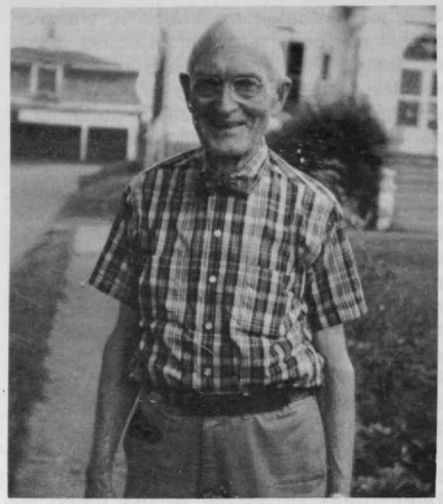
the most faithful of my correspondents. He keeps busy with his work for the American Association of Retired People, visiting with neighbors (mostly widows) and cutting lawns. He wished us all well at the reunion. . . . **Walter Wilson** had a stroke a couple of years ago which affected his right side. After a lot of physical therapy he is able to walk short distances with the help of a cane. He does not drive but nearly every day gets to his factory where 300 men turn out metal products.

Paul Cushman had planned to come to the reunion, but was struck by a truck late in May. He suffered a broken hip which put him in the hospital for months. Before his accident he had been very active, walking up to ten miles a day, so hospital life was not to his liking. . . . **Richard H. Gould** wrote that although he and Anna are reasonably spry for their age they did not feel that they could make the reunion. Dick has practiced his profession of sanitary engineering for sixty years, twenty-five of them directing the Pollution Control Program for the City of New York, and the rest in private practice. He is proud of his family: Anne married to a lawyer in Hawaii, Frances to a rancher near Santa Barbara, Dick, Jr., an architect in Sausalito and Prescott with his wife and five children outside London. . . . **Allston Cushing** received a silver emblem pin for having served 2,500 hours of volunteer service to the Veterans' Administration Hospital in Kansas City. He and Luella celebrated their golden wedding anniversary on June 29. —**Oberlin S. Clark,** Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

DO YOU REMEMBER the story of the physics exam that appeared in the *Technique*? Question: Describe Gallileo's experiment at the Tower of Pisa. Answer: He dropped cannon balls from the top of the tower into tubs of water at the bottom and noted the rise of temperature. Contributed by John Hall.

I have a letter from George Bakeman, Hanover Courthouse, Va., telling how much he enjoys our class news. He spent two years with our class and made many friends but is now officially in 1913 since he had to leave and work for a year before returning. He attended our 50th reunion in 1952 and says we may expect to see him at our sixtieth next year. He writes, "There is always a welcome at my home, 'The Oaks' near Richmond for members of 1912 or 1913." Thank you, George. . . . The following information regarding **Arthur Bennis** of Montclair, N.J. was furnished by his wife, Lucy. After two years with our class, Arthur transferred to Marquette University, Milwaukee from which he graduated in 1912. He then returned to his native Punxsutawney, Pa., where he became a C.P.A., heading his own business. He later entered the federal service, becoming chief finance officer at the V.A. Hospital in Butler, Pa. In 1950, he transferred to the V.A. regional office in Newark, N.J., and moved to Montclair. During World War I Arthur joined the navy and was assigned to troop transport and escort duty. He was on the U.S.S. *San Diego* when it struck a mine, sixty miles off Fire Island, and sank with thousands aboard. All but six sailors were rescued, after five hours in the water. He married Lucy McNamee of Brooklyn and they have one son, three daughters, and 16 grandchildren. Ten years ago, Arthur became a victim of arteriosclerosis forcing him to retire. He is a patient in the V.A. Hospital in East Orange, quite helpless and considerably out of touch with life. All of us deeply regret this sad ending to an active and useful career. The class extends to Arthur, his wife and family our most sincere regards. . . . **Phil Jones** writes from Naples, Fla., that in April, 1970 he remarried a widow who lived in Boston. He says he is greatly enjoying life and expects to continue to live in Naples for the rest of his life. Our belated, but sincere congratulations, Phil. . . . **Howard Cather** writes that he and Liz are already planning to be in Florida next February and March. Yes, we hope to be able to have that bridge game we planned for last year.



Jim Cook, '12, at home in Marblehead, Mass.

Willis Salisbury, our perpetual traveller, spent six weeks last winter in Curacao and Aruba, where he enjoyed a nice rest, with much swimming and sun bathing. "Food and lodgings were excellent, though all food and supplies had to be imported except for the fish, which came in daily by the boat load, and the fresh fruit and vegetables from nearby Venezuela. A steady procession of oil tankers and cruise ships arrived daily. During the day, it was quite hot in the sun but the trade winds kept the evenings cool and comfortable. I met some nice Dutch people and enjoyed a tour of the large Shell Oil refinery. On Aruba, I could watch the big cruise ship at the town pier from my hotel. After breakfast, I would walk down town, watch the gift shop patrons and look over the haul of fish and the unusual fresh fruits and vegetables. Most of the inhabitants are black, descendants of African slaves, brought there by early explorers. I was fortunate to be on Curacao during the annual carnival and parade, and took many photos. The costuming was bizarre, and most of the marchers danced on the hot asphalt in bare feet. There is little scenery on the island worth seeing, but it is an excellent place to go for a rest."

And now a note from **Jesse Hakes,** another of our frequent travellers, who writes, "You will be interested to know that we have signed for another long cruise. We leave New York January 5 on the *Sagafjord* and return April 7. We shall cover a good deal of old territory but some that is new to us. Our territory takes us through the Panama Canal and then out across the South Pacific, including Tahiti, Fiji, New Zealand, Australia, Singapore, Bangkok, Hong Kong, Japan and Hawaii. We shall return via San Francisco, a few stops along the coast, back through the Canal and home." Bon Voyage to you both! . . . **David Guy** reports that last spring he had a bout with viral pneumonia and has needed a cane to get about. For this reason his beautiful rose garden which he enjoys so much, has suffered. His condition seems to be improving and we hope that it will so continue. "I am looking forward, hopefully, to the reunion next year." . . . Here is a sad report about **Early Kilmon** from his wife, Sally, postmarked Onancock, Va., on the Eastern Shore. He was with our class only during the freshman year in Course VI and spent most of his career with Standard Oil at their Cape Charles plant. "I wish to tell you that Early is an invalid. He has been confined to the house for five years, and unable to write. Father Time has really taken his toll. Early is 85 years old." In behalf of the Class, we are sending our sympathy and best wishes.

Fred Busby has sent me a covered bridge article from the *Boston Sunday Herald* together with a letter. He is interested in the subject as he worked for thirteen years as a designer of modern bridges. Fred writes that his health and faculties are still good and that his only vice is cigarettes. As you know he has been teaching in Cambridge for many years. He has now decided to retire, however, due to the problems incident with winter travel by car and subway. The steps are getting much longer. "I do look forward to next June and hope to see all of our living classmates." . . . **Clarence Woodward** sends this news, "I hope to attend our 60th next year if I am still around. Presently, I am in good health. I still play duplicate bridge, in fact as of this year I am rated as a life master of the game. Last spring, we visited my daughter and family in Marietta, Ohio and then drove to Parkersburg, W.Va., where I visited the same hotel I had last stopped at 52 years ago. There was little change over this long period. Another time at the golf club, I mentioned working in two mines in Kellogg, Idaho while I was still in Tech. A club member, living nearby spoke up and said that he, too, had worked there 25 years later. So time does not always erase old memories. Incidentally, I still keep up with my astronomy and recently viewed the planet Mars at its nearest point to earth in fifteen years, 35 million miles distant."

We sadly report the sudden passing of **David Follett** in Adams, Mass., on July

25, due to a massive coronary attack. Dave spent most of his career as head of the New England Lime Co. and served as an executive of the local bank for over 20 years until his retirement in 1964. We have sent a note of sympathy to his wife, Helen.

We were also shocked to learn of the death of our old friend, **Jack Lenaerts,** which occurred without warning on September 18 from the same cause. The Lenaerts had spent the summer on Cape Cod as usual and were about ready to return to their apartment in Venice, Fla. Our sympathy and that of the Class were forwarded to Marion and to his son Jack, Jr. and family.

At the last moment I received word of the sudden death of **John Pettingell** in Acton, Mass., on September 8. John was an active contributor to our column and only last June, he attended the Homecoming luncheon and told me he was looking forward to our 60th reunion. He had somewhat recently founded Pettingell Associates, specializing in air pollution products. He was also active in several historical societies. He leaves his wife, Ruth, and a son and daughter as well as six grandchildren. We send the deep sympathy of the Class of 1912 to Ruth and the family.

Good news from **Jay Pratt:** "At the last visit our doctor told us we can return to Acapulco this winter, and we are both delighted. You know how much we love it. Priscilla and I are both feeling better, though she is taking pills and I am very lame. I hope I do not have to use a cane. Despite the hot summer, my garden has looked very lovely and I was able to work in it every day. It is good therapy. Priscilla and I play bridge often and she has played golf (9 holes) weekly. Here is an article on Illinois covered bridges and some garden photos you may enjoy."

Well, the leaves are starting to fall and we should soon be thinking of Florida. A review of our list shows that there are now 23 who have advised they are planning to attend our 60th reunion and 19 others who are much interested. This indicates that we may reach our goal of 40 who will be present. By the time you read this, you should have had a letter from Albion Davis, our Reunion Chairman. Please reply promptly. There is much work to get things ready.—**Ray E. Wilson,** Secretary, 304 Park Ave., Swarthmore, Pa. 19081

13

Well here we are in our new "Retirement Home" after a year and a half of planning and building. The house is ideal and a very satisfactory structure. We are very happy and are really enjoying our pleasant mode of life. **Charles Thompson** phoned us a short time ago. This week we enjoyed a visit and luncheon with Ellen and **Bill Brewster.** They were returning back to their home in Plymouth, Mass. We had hoped to attend the inauguration of our new President of M.I.T., but due to illness of Roz's mother, it was impossible.

The response to our "due bills" has been very gratifying: 70 of our class or relatives have replied; 14 did not vote, 26 expect to attend our 60th reunion, 17 do not expect to attend, 10 question their ability, 7 hope to attend. As to location of the reunion, 23 prefer the Cape; 4 voted for the North Shore; 12 prefer on campus; several will go anywhere; several voted to go to the North Shore or on campus; several voted to reunion on the Cape or on campus. So until the Fall of 1972, keep planning for our 60th reunion in June 1973. We have received some interesting letters, notes, and comments. **Phil Burt** will attend the 60th "if on the Cape." **George Sampson** stated "Expect to be hospitalized about that time." **Bill Brewster** adds: "We hope." **Joe Isenberg** sent "many happy returns and good wishes."

Herb Shaw writes: "It was nice hearing from you and to judge that you are in your new retirement home. Leila and I earnestly hope that you and your lady will have a long happy life together there. You have left many of your old friends, and you will miss them, and they will miss you also, but you folks have the knack of making friends, so we expect that you will find new friends in your new home. Good luck to you. About the 1973 reunion . . . right now I would not care to drive in or through Boston and by 1973 I would not try it, so my vote is for the Cape. We would like to hear from you folks. We are particularly concerned as to how you made out with your eye trouble. The good results I had with my operation makes us concerned as to how other people make out. We are still in good health. Leila has knee trouble and uses a cane outside of the home. She is active in Women's Club work and I keep busy with my clocks and basement workshop. I am sending you a pencil caddy of my making, for your desk. Good health to you, and we hope to hear from you sometime."

William ("Jack") **Horsch** writes referring to the reunion: Too early to predict," and adds "Presumably you are building or have built your retirement home—in either case enjoying it. Our younger daughter lives in Guilford, Maine. Just possibly Gertrude and I might detour from the turnpike to Biddeford to say hi to you on one of our trips north." . . . **Allen Brewer** writes: "Here is my check for $2 annual dues. Also I have checked regarding our choice for the 1973 reunion. Maurine and I are sure that 'if the creek don't flood', we will be with you folks wherever the final decision is made. Naturally we favor the Cape. Now for up-to-date news from the Sunshine State. Lots of that lately, but not too much rain. We thought we might be getting the recent blow which passed by your way, but nothing doing. So we just sweat out each weather report from the Indies when a tropical disturbance is rumored. So far our 'fingers have been crossed' to good advantage. Healthwise we are both 'fit and rarin' to go'. My cataract operation of last May has been successful, now I'm getting used to wearing contact lenses. A bit different at first, but now that we have gotten the hang of it I believe I like it. Sure can spot the bikinis well. I had another stamp article published in the *Minkus Stamp Journal* in July. Dealt with 'Bridge Designs on Stamps of the World'. Then in August the *Philatelic Footnotes* of the Texaco Stamp Club published my article 'Historic Philatelic Florida'. Would you like to have a copy, since you are familiar with our State and its advantages? As ever with best wishes to you both."

Art Kenney adds: "Very unlikely—how did you happen to move to Maine? My native state." (To be near our older daughter and her husband.) . . . **Dave Nason** always has good comments and we quote: "You take your job of class secretary seriously. Your solicitation of the survivors of 1913 reminds me of my experience with a colored street-walker on the eve of my 80th birthday. I thanked her profusely. It really did set me up. She received a rewarding gratuity for her perspicacity. More seriously, it's a pleasure to know that our class is operating in the black, thanks to your energy. Why don't you raise the ante? The postal advance to 8 cents makes $5 per a necessity, and at $10 you might keep your office profitable. And I am sure no one would turn you down. I would like to be there in June 1973, and will be if I am here. Kindest regards." . . . **Robert Smith** responds: "No, too old—90 years." **Bob Tullar** writes: "Thanks for sending the notice about dues and the 60th reunion. And thanks much more for being such a good and untiring secretary for all these years. We will miss more old friends at the 60th, but it's comforting to believe that they are happy and making others happy in the great beyond. Beulah and I are enjoying good health at a slow pace, and I hope the same for you and yours."

Marion Rice Hart, our "Flying Gal" is very much concerned where she may be in June 1973, "at home or in the skies." . . . **Clarence** "Jim" **Brett** states: "Sorry, don't think we can make it this time. How do you like the rock bound coast of Maine. Bet it is cooler there than the summer temperature here in Scottsdale." . . . **Gordon Howie** remarks: "Congratulations on being in some nice clean air in Maine. Ethel and I always liked it on the shores of Drake Island, where we once lived. Thought I better send in my class dues while the price freeze is still on. Although you have always been a master in handling that item. Best wishes for happy times in Maine." . . . **John Hession** notes: "Unable to attend unless wife recovers sufficiently in the meantime." . . . **Fred Lane** writes: "Here is a check for dues. And this is an opportunity to wish you and Roz happiness in your new home. Hope you have been well. We have done fairly well for persons of our age. We hope to last long enough to attend the 60th. Have suggested the Cape as a meeting place, realizing that that means a little longer drive for us. Anyway, we have the feeling that a quiet, restful place may be what we will need most at that time. Maybe the Cape isn't the answer. You pick the place and we'll do our best to be there." . . . We had a dues bill returned "address unknown" from **Arthur G. Eastman,** 2405 Canter Way, St. Louis, Mo., 63114. Can any

classmate give us any information regarding Arthur's correct address?

So boys and girls, we shall continue reports of more classmates in January's *Review*. If any of the members of M.I.T. Class of 1913 visit Maine, visit us or call us at 207-282-2745.—**George Philip Capen,** Secretary and Treasurer, **Rosalind R. Capen,** Assistant Secretary, Granite Point Rd., Biddeford, Maine 04005

14

Bob Townend wrote last April that he and Maude had spent that month in the south, visiting their two daughters and their families and seeing some of the ante-bellum homes and floral gardens. In August he wrote to Ray Dinsmore and to me, "In June my wife and I took an American Association of Retired Persons bus trip to New England and Nova Scotia. Actually we took a somewhat similar trip in our own car just 25 years ago. One night on our recent trip, at Woods Hole, Mass., I took the occasion to call up **Elwyn E. Snyder** who graduated with us in Course X and got his M.S. under Dr. W. K. Lewis. He is retired and lives at Bay View, West Chatham, Mass. He said he has three daughters, one son and 16 grandchildren. His health is pretty good at present but he had a little trouble some time ago.

"I was one of the original Honorary Secretaries for the M.I.T. Admissions Department and am now in my final appointed year of approximately 35 years. Today the question of enrollment is paramount."

H. S. Busby, in his letter of last August, speaks of his successful cataract operations in January and adds, "There is a prolonged period after the operations when eyes don't focus properly but you eventually get reoriented. However, in the meantime, one can do some work; I 'researched' nearly 3000 pages of text and documents and wrote a project on the history of a college/farm community here. It was a slow, laborious work but I finally brought it off. This seems to be a period of 50th anniversaries. The Colorists and Chemists Society, of which I am a charter member, is having one in Boston, in October, and there is another one (of the Southern Division of the same society, which I started) to be held in 1974."

Our sympathy goes to the families of four classmates whose deaths have not previously been mentioned in these notes. **Henry F. Merrill** died in his sleep at his home in Amherst, N.H., on November 24, 1969 at the age of 79. He was with us at the Institute for the last three of our undergraduate years and received his bachelor's degree in Course XI. He spent 26 years in China, first in flood-prevention engineering for the Chinese government and as an engineer in the public works department of the city of Shanghai. For most of his career in China he was with Standard-Vacuum Oil Company in Shanghai, where he became manager of manufacturing and production. His last two years before his retirement in 1945 were spent in New York, with the same company. After that he lived for 22 years on a 40-acre farm in Amherst, where he filled several town offices, including those of Trustee of the town's trust funds, and Secretary-Treasurer of the town library. He was a member of the First Church of Christ Scientist, of Milford, N.H. Henry is survived by his wife, the former Kathleen B. Atkins; two daughters, Mrs. Phyllis M. Klehm, of St. Louis, and Mrs. Elizabeth M. Wight (whose husband, M. Arnold Wight, is M.I.T.'40); a brother C. H. Sayre Merrill, M.I.T.'13; a sister, Mrs. Grace Emery; and two grandchildren.

Albert N. Henricksen died in New Haven, Conn., on May 13, 1970. He joined our class in our junior year and graduated with us in Course II. During his early career he was employment manager of Holtzer Cabot Electric Company, of Roxbury, and later was in the Division of Industrial Cooperation at the Institute. In 1935 he joined the staff of the Brooklyn Museum, in New York, and was its business manager and assistant director until his retirement in 1965. From then until his death he lived in Milford, Conn. He was a 32nd degree Mason, and a member of Aleppo and Balbec lodges in Boston. He left his wife, Grace, and a son, Albert N. Henricksen, Jr.

Edwin D. Hayward died on May 30, 1970. He was with us for all four of our undergraduate years, and received his bachelor's degree in Course I. After teaching at the Institute and at two other universities, he entered military service in 1917, and was discharged in 1919 as a captain of Sanitary Engineers. He then spent several years in Java as manager and chief engineer of a San Francisco export-import firm, and four years as assistant chief engineer of the Sacramento Municipal Utility District. In 1926 he joined the consulting firm of Production Management Engineering Associates, Inc., of San Francisco, and became its president in 1954. After retiring from that position in 1961, he was for some years an independent consultant as a specialist in problems of production management. He is survived by his wife, the former Emilie K. Gogel, and by two sons, Daniel Elliott and Kenneth Norman, and six grandchildren.

John E. Giffels died on May 12, 1971, after a short illness. He was born in Boston in 1892, and was with us in all four years at the Institute. After graduation in Course II, he was for some years an engineer in the paper-board and construction industries. In 1924 he married Marion H. Carroll, who, with their daughter Carol Ann, of New Orleans, survives him. In her letter reporting John's passing, Mrs. Giffels wrote, "He retired twelve years ago as project engineer for the U.S. Rubber Co. in New York, and spent his retirement years in Hampton Bays, Long Island, swimming, fishing, boating, and enjoying nature and the Atlantic Ocean and life in general. John never tired of telling about the M.I.T. of his day and comparing it with the M.I.T. he saw at his 50th Reunion, which was one of the highlights of his recent years."

The death of another classmate, **Leonard L. Stanley,** has been reported, but I have not been able to obtain enough information for a note about him. Can anyone supply it? . . . We have a new address for Alfred P. Kitchen, 65 Elizabeth Avenue, New Rochelle, N.Y. 10804.—**Charles H. Chatfield,** Assistant Secretary, 177 Steele Road, West Hartford, Conn. 06119

15

A sad loss to our Class was the sudden death of Admiral **Bill Smith** on August 21 in Boston. Since his retirement seven years ago he had been very active and interested in all class and alumni affairs. The finale to our annual class cocktail party on Alumni Day was a visit to his 19th floor apartment with his sisters as hostesses, for cordials and a spectacular view of the lighted M.I.T. buildings, the Charles River and suburban Boston. Bill bequeathed a substantial sum to M.I.T. Representatives of our Class attended his services in Concord, Mass., and expressed our sympathy to his two sisters. Bill, a Boston native, retired from the U.S. Navy in 1948 as director of the Atlantic Division of the Navy's Bureau of Yards and Docks after being awarded the Legion of Merit for "outstanding services" during World War II. He began his career with the navy as an assistant civil engineer two years after his graduation from M.I.T. and by the beginning of World War II was public works officer of the New York Navy Yard. In 1942 he was made superintending civil engineer for all navy-sponsored construction in New York, New Jersey, Delaware and Pennsylvania. Later that year he went to Washington to serve as chairman of the Facility Review Committee of the War Production Board. In 1943, he was named director of the Planning and Design Department of the Bureau of Yards and Docks, and later the bureau's chief planning officer. After leaving the navy, he became chief engineer of Palmer and Baker Inc. of Mobile, Ala., from which he retired as vice president in 1963, and retired to Boston. He was buried in the Arlington National Cemetery. We'll miss Bill but we'll never forget him.

At the September 9 lunch meeting of the downtown alumni in Boston our Class was represented by Whit Brown, Clive Lacy, Archie Morrison, Wally Pike, The Pirate and myself—the largest attendance from any class—surely ours is the Class Supreme. We had good company sitting with us—Dave Patten, '16 and Russ Ambach, '24. Attending Alumni Day activities in June at M.I.T. were Whit Brown, Hank Marion, Archie Morrison, Wally Pike, The Pirate, Fred Waters, Pop Wood and Max Woythaler. All came over later to our Class cocktail party and dinner at the Faculty Club.

It's good to report **Jack Dalton** has recovered from his recent illness. Keep well, Jack! . . . Our newly found classmate, **Bahjat Abdulnour,** writes from Beirut, Lebanon: "Many thanks for the July *Review,* I greatly appreciate your publishing my letter in our class notes. Good luck to you all and my heart-felt and sincere thanks." There's something particularly warm and stirring in hearing from him so far away. All the best to you,

Bahjat. . . . This summer we had lunch and an interesting visit with Helen and **Phil Alger** at their mountain hide-away in Rumney, N.H. Despite his being retired, Phil's active mind is working on the manuscript of his new book *The Human Side of Engineering.* He submits the following apropos bit and how true it is. "BEING 80! Being 80 is quite an adventure. Everyone wants to carry your luggage, and help you up the steps. If you forget something, spell a word wrong, spill soup on your necktie, or wear nonmatching shoes, you have the perfect alibi. No one expects much of you. It is a great deal better than being 65 or 70 when everyone expects you to become simply a has-been. At 80, everyone is surprised that you are still alive, can walk, can talk above a whisper, and reveal signs of lucid intervals. At 70, people are mad at you for everything. At 80, they forgive you for everything. So you, as I, can say—LIFE BEGINS AT 80!" From Phil's we went to dinner at Helen and **Boots Malone**'s delightful place in Chester, Vt. It's wonderful to visit with old classmates and their families and renew and relive the past years.

Evers Burtner has retired to West End Bartlett Beach Dr. in Kingston, N.H. He writes: "You will be surprised at our new address. Mary and I decided to build a one-floor house (we have a big attic for books and gear and a good sized cellar for shop tools etc.) The move from our rather large home in Wakefield was quite a problem. We in Kingston are in a private development which has its own bathing beach, boat landing, and picnic spot. I still enjoy sailing. Will be glad to have any fifteeners or other friends drop in. Was sorry to have missed last June M.I.T. events." . . . **Larry Bailey** was in St. Luke's Hospital in Middleboro, Mass. in September for surgery. Larry has had more than his share. . . . We are all sorry that Bill Morrison, the manager of the M.I.T. Faculty Club, is leaving. A graduate of that famous Cornell course in Hotel Management (Class of 1936), Bill opened the Faculty Club in May 1952 and we feel has done an excellent job. He always took a friendly and personal interest in our class affairs there to make them so successful and enjoyable. We'll miss him greatly and wish him all the best. . . . **Frank Murphy** has had enough of the Boston snow and ice and has retired to 65 Angelo Lane, St. Augustine Shores, Fla. 32084. . . . From Sherman Oaks, Calif., **Ben Rivers** wrote: "I'll be 80 my next birthday and I don't like these years. I no longer drive—my wife does it for me. I'm running on batteries with a Pacemaker. When the batteries run down, I do too—quite inconvenient. I play shuffleboard, read, walk about a mile each day and get around. Best regards to everybody—especially Bert Adams." . . . While passing through Boston, **Mary Plummer Rice** phoned and talked to Fran. While here from Philadelphia last summer **Sol Schneider** phoned me. It's always good to hear from visiting classmates.

We are sorry to report the death of **Edwin B. Goodell Jr.,** on September 16, 1971 in Wayland, Mass. . . . Our sympathy goes to **Ray Walcott** in the sad loss of his wife Pat, who passed away July 24, 1971.—**Azel W. Mack,** Secretary, 100 Memorial Dr., Cambridge, Mass. 02142

16

As these notes are read Christmas festivities will be getting under way and your Secretaries extend greetings and thanks for helping our classmates keep in touch with each other by your correspondence. A goodly number of items have had to be held over since spring due to space limitations but as they are still of interest we include them here. A note from Warren Henderson, '33, tells us that **Gonzalo Garita** is still very much on the go and attended the 1971 M.I.T. Club Fiesta in Mexico City. Mr. Henderson lists some 23 other M.I.T. men who attended the Fiesta and expressed the hope that they and others would attend next year.

Chet Richardson of Youngstown, N.Y. writes expressing regret at the passing of **Eric Schabacker.** The last time he saw Eric was about five years ago when he was visiting Ray Brown on his way home from the 50th reunion. "He, Ray and I had a pleasant private reunion in the little village park in Lewiston, by the Niagara River." In a later letter, Chet reports with regret the death of **Osborne** (Os) **Mahlman** in July in the Fairchild Nursing Home in Lewiston, after a long illness. Os was a native of Lubec, Maine, and was formerly assistant manager of the Patents Branch of the Carborundum Corporation of Niagara Falls for 16 years. Chet says that this leaves him as the only '16 survivor of Course XIV, known among the undergraduates as the "dirty dozen." He continues growing cherries—"sweets, no sours" he says—and had a 30-ton crop this year—his biggest so far. Hope he doesn't ever have our current problem in Mountain Lakes, N.J.—gypsy moths—that have laid little yellow patches of eggs on our oak trees—red, black, pin, white, chestnut—aiming to be galloping hungry caterpillars next spring!

John Fairfield comments about birds and such around his home in Troy, N.Y., in the spring season and says he continues to throw out sunflower seeds so the pheasants, cardinals, brown thrashers, stick-pin sparrows, and red-wing blackbirds come regularly. Recovering well from some sickness last winter, he notes that the storm sash are off, screens on and most of the garden planted or turned into grass, thanks to hired help. . . . Speaking of gardens, in May **Frank Hastie** said that except for potential problems of squash stem borers, his "little old garden" in Dowell, Md., looked good, for the weeds were still low despite the encouragement of a recent downpour—what he called a "two aspirin storm." "Two aspirin," he explained, because when his fellow geriatric, 14-year-old canine pet Impy really suffers during thunder and lightning, normally a single aspirin is sufficient to calm her but when a storm is very severe two aspirins are needed.

Willard Brown wrote from Santa Barbara in April that he and Dorothy continue a fairly busy life. When he had a conflict of four events all in the same evening, some time ago, they settled for the bus tour via Hollywood to see a dress rehearsal of the Lawrence Welk Show with much fun and skylarking at rehearsal breaks. He continues to spend some time working for "the general good of the order," helping to maintain the lovely character of Santa Barbara, making it "a truly halcyon spot for us retired folks" and above all "keeping out the 'quick buck' boys, who often try to storm our citadel and bring in high-rise apartments and hotels and commercial buildings. For my money they sure have spoiled just about all of Southern California, on and near the coast at least. And how they would like to do the same here. That's one reason we have a considerable number of improvement associations from each local area who try to keep a close watch, especially when their own 'ox is about to be gored.' I helped organize our Grove Lane District Improvement Association some years ago."

A clipping from the *Boston Globe* of June 6 amplifies a previous note about **Jap Carr:** "M.I.T. president Howard W. Johnson announced the plans for the construction of the J. B. Carr Indoor Tennis Center which will be an air-supported, inflatable structure located on the Briggs Athletic Field, near DuPont Center and adjacent to student resident halls along Memorial Dr. The building will cover four existing tennis courts and is expected to be finished by September. It is a gift from Mr. and Mrs. J. B. Carr of Wilkes-Barre, Pa. and Palm Beach, Fla. and from their son and daughter-in-law Mr. and Mrs. Davis B. Carr of West Palm Beach." (*Further details of the structure are in the October/November issue, p. 93.—Ed.)*

George Crowell has just retired as a banker but not yet as the moving spirit of the company he has directed since back in the 'teens. In the May 12 issue of a Brockton paper we read, "At the directors' meeting of the Plymouth-Home National Bank of Brockton in May, three newly-elected directors were inducted and two directors were retired. George I. Crowell, owner of the T. F. Crowell and Sons, is retiring after 38 years as a director. He assumed the management of the T. F. Crowell and Sons subsequent to graduation from M.I.T. in 1916 and has since directed the company to a prominent position in the field of general contracting. Crowell has been active in community roles in varying capacities and has also served other local financial institutions. He is a past president and trustee of Peoples Savings Bank, and past vice president and director of Campello Cooperative Bank. George will continue on in an advisory capacity." . . . **Brad Curtis** writes in April of many activities which would indicate that time does not hang heavy: "Mrs. Curtis and I have been in reasonably good health considering our ages. We enjoy life. We now have two great grandchildren, one boy and a girl. The last, a girl, was born in August, 1970. Our grandson, Charles N. Bacon, graduated from the University of Delaware in June, 1970. He recently went into the Internal Revenue Service, the Division of Alcohol,

Firearms, and Tobacco. They give him an 18-month course before placing him in a permanent location. As usual we went to Skowhegan, Maine, last summer for a short visit. This past March we visited friends in Sarasota, Fla. While there we went to see the Ringling Brothers estate now operated by the State of Florida. The Ringling residence is most interesting . . . the museum with its many oil paintings, marble floors, and many statues from Italy, all in a well-designed courtyard. I am a Course VI man, electrical engineer, but I do enjoy good architecture. Another building houses antique circus equipment not now used on the road. A good place to take small boys."

John Gore wrote in April from Canajoharie, N.Y.: "We had a record snowfall this winter of 10 feet in this area. Many buildings collapsed and we were kept busy digging out." He added that on April 23 there was still snow covering the area. "We, as you know, are 'birders' as they call them. That is, bird watchers or bird counters. We keep track of the new birds showing up every day. Each day we see one or two new ones for the season. A few days ago we saw 33 different species in one day. Along the Mohawk River here we see all kinds of ducks and water fowl."

Merrick Monroe wrote from South Waterford, Maine, early in June where he and Miriam were located for the summer "ready to loaf," as they let others enjoy their home in Noroton, Conn. Speaking of times gone by, Merrick says his ancestors, both maternal and paternal, "have been here since the Revolution. My wife's father established his medical practice in Harrison, Maine, in the late 1890's: axe-cuts and babies, some paid for; office visit, 25 cents. I pay my doctor $12 per call! Times have changed!" This reminds us of prices in Massachusetts at the turn of the century—errands all over town for the neighbors in Lowell, two for 5 cents; Sunday papers delivered for ¾ cents each; milk at 5 cents a quart delivered; and for working after high school in patent office drafting, a starting pay of 5 cents an hour! Merrick is right, times surely have changed.

Saul Hoffman wrote last May: "**Barney Gordon** was out here in Los Angeles and we visited together and had a great time reminiscing old times. He's quite a guy. Personally, I am still abstracting and I guess I will, God willing, as long as I live. Otherwise, nothing much new to say, except we're getting older. Philosophically—just keep smiling and be happy." . . . A card to your Secretary dated June 2 from **Harold Mills** our astronomer tells of a hobby vacation in Colorado: "We have been in a nice cottage at 8,000 feet elevation at Estes Park, low humidity and fine 'seeing' in the early mornings generally at one to four a.m. See the Milky Way, our galaxy, which we can't see in Mountain Lakes, N.J., territory because of humidity—large clouds in most evenings. Estes Park is a nice town surrounded by mountains."

Since our last notes we have had word that several of our classmates or their wives are no longer with us and the sympathy of the class has been extended to the families. **Arthur Caldwell, Nat Warshaw,** and **Frank Ross** have lost their wives recently and we have just had word that **Norman Thompson** died in September. Notice of the death of **Henry Hunter** on September 30, 1970, and of **Charlie Walter** on April 26, 1971, may have inadvertently been omitted.

Class of 1916 at their 55th Reunion at Chatham Bars, Cape Cod, in June, 1971.

We have just received a picture of the Class at the 55th Reunion, reported in last month's issue. Copies have been sent to those attending and more copies are available from your secretaries, including names according to position in the picture.

To keep the slogan going: write us often, even if only a little bit; the more the merrier and your willing-to-work Secretaries will spread the word.—**Harold F. Dodge,** Secretary, 96 Briarcliff Rd., Mountain Lakes, N.J., 07046, or **Leonard Stone,** Assistant Secretary, 34-16 85th St., Jackson Heights, N.Y. 11372

17

Here is SPECIAL news of changed plans for our 55th reunion next June at Chatham Bars Inn, Cape Cod. Chairman **Tubby Strout** submitted a new idea at the business meeting of our 54th at Northfield which was eagerly accepted. Instead of the usual Friday, Saturday, Sunday routine, the change is to Monday, Tuesday, Wednesday, June 5, 6 and 7. More details will be forthcoming in a "1917 News". Briefly, weekend congestion is minimized, the Sunday campus events including the Pops concert and Homecoming Monday, can be enjoyed with campus lodging Sunday night likely. Possibly bus transportation to and from the Cape will be arranged. Those desiring could go directly to the Cape, bypassing Cambridge. Chatham Bars Inn, as those who attended our 50th know, has excellent accommodations including the special clam-lobster bake facility. The area is a fascinating one and plans for trips and other entertainment are being made. Tubby will appreciate your comments and suggestions.

There still are some hard working members of the Class and they may object to the reunion time change. In connection with the Northfield dates **Bill Eddy** commented, "These are working days!" **Raz Senter, Tom Meloy, Earl Lewis, Frank Peacock** probably would say the same. Who else is still working?

Judging from comments, the 54th reunion at Northfield in October was one of our best. A congenial group of 29 men and 23 wives enjoyed good weather and foliage. Although the Northfield hydro project is behind schedule it was, again, an interesting tour. The group was privileged to hear Susan Williams Lunn at the piano and to view **Stan Lane**'s travelog picture of Portugal, Spain and North Africa. **Ed Aldrin** gave a treat with a tape recording of Buzz Aldrin's impressive response on his being honored by the New York Masonic Grand Lodge. President Lunn conducted the annual meeting and reported that the Buzz Aldrin Scholarship Fund, a 1917-55th reunion project, stood at 57 per cent of its $100,000 goal and that the indication is that next June the Fund will total about $70,000 unless some substantial gifts are received meanwhile. Treasurer Stan Lane reported that recent contributing had brought the balance up substantially so that the 55th reunion expenses could be faced with cautious confidence. A nominating committee consisting of Messrs Erb, Cristal, and Strout was appointed to report a slate of officers to the 55th meeting. Several of the group went on to Cambridge to attend the inauguration of President Wiesner. The attendees at the reunion were: the Beadles, Dud Bells, Butterworths, Cristals, Dennens, Dunhams, Dunnings, Erbs, Gilmours, Holtons, Hunters, Stan Lanes, Ken Lanes, Lunns, Neubergs, Rosses, Al Sullivans, Wilsons, Severances, Solakians, Ray Stevenses, Ferretis, Mahers and singles, Aldrin, Flaherty, Henderson, Hill, DeBell and Strout.

It was gratifying to have reunion postcard replies from 76 men, many with messages. Our class roll now is 284, down from the original total enrollment of 659. Reunion notices were sent to the 53 widows on our mailing list. The 15 replies indicated genuine interest and expressed appreciation at being invited. A special effort is going to be made to have the widows attend the 55th. Vi Proctor has agreed to assist in the program.

With the closing of Volume 73 of the *Review* it was interesting to note that 84 men had been mentioned in our 1917 notes, not as many as desired but still a good percentage of our enrollment. You can make it better though.

Ray Brooks was reported recuperating

at home after major abdominal surgery last August. . . . **Penn Brooks** spent a week in the Canadian wilds with a son and a grandson and was spending most of October in France. . . . **Jim Ferrall** retired on June 1 after 44 years with the Chicago office of Bache and Co., Inc. . . . **Ray Ramsey** and his wife will go next spring as auditors on the "World Campus Afloat" as they did in '65 and '66. . . . The **Ham Woods** are just back from a western Canadian trip. . . . The **Franklin Dexters** celebrated their 55th wedding anniversary on July 22.

John Parsons formerly vice president for pulp and paper at Calkin and Bagley, Inc., received the 1971 TAPPI Research and Development Division Award for outstanding contributions to TAPPI and the pulp and paper industry in research, technical management writing, translation and leadership. . . . **Howard Melvin** has a new address, 375 Rock Green Place, Santa Rosa, Calif. . . . At the time of the reunion **Noah Gokey** was just back from a trip north, **Connie Coakley** was off to Hawaii, **Luther Lauer** was in Guatemala, **Barney Dodge** was off for South Africa, **Win Swain** was back from a six weeks trip to the Northwest, **Luc Schoonmaker** was back from Europe, **Rad Stevens** was recuperating from a "complete hip removal."

Regretfully the deaths are recorded of: **Daunis E. Braud** at New Orleans in October 1970; **Donald S. Kendall,** President of Mack Molding Co., Arlington, Vt., on December 5, 1970; Admiral **Frederick G. Crisp** at Saratoga, Calif., on December 9, 1970; **Morris M. Brandegee** of the Hooker Chemical Co., on June 12, 1971 at Youngstown, N.Y.; and **Harold J. Quilhot** at Hendersonville, N.C., on July 14, 1971. —**Stanley C. Dunning,** Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard,** Assistant Secretary, 21 East 87th St., New York, N.Y. 10028

18

Since writing these notes for the previous issue, Dr. Jerome B. Wiesner has been installed as the 13th President of M.I.T. I attended this low-keyed function—a sign of the times and the problems of the day. Following our graduation after World War I, technology and science blazed the trail in making nature's resources serve man for his benefit—prolonging his life and raising his standard of living to undreamed-of heights. Today the emphasis is in a new direction, to use technology and science to solve baffling societal problems of poverty, pollution and war. Eighteeners join with all alumni in wishing Dr. Wiesner great success in his leadership to meet these challenges.

Now to the rather sparse news of the immediate past. Our genial class agent, **Julie Howe,** departed for Europe in September for a month's holiday in Italy. Unfortunately, his Elizabeth fell in a church in Assisi and broke her hip. She was flown home at once, and is confined to her bed for three months. We have every reason to believe that she will make a complete recovery and will be as good as new.

Our world travelers, the **Thomas Brosnahans** mailed a post card from Panama, July 16, depicting a rock-bound shore scene with seals on Floreana Island, Galapagos, Ecuador, South America, as follows: "In the 18th century, a barrel Post Office was set up in the Galapagos Islands for whaling ships that expected to be at sea for two years or more. Ships that had completed their voyage and were headed for their home port picked up the mail. It required two months to two years for the addressee to receive it. This card will be placed in the same barrel. It will be interesting to note the date you receive it. We met Cecil Green '23, former president of M.I.T. Alumni Association. They are also world travelers." I believe I received this card about August 13.

We regret not seeing the **Ed Rossmans** this summer. They were in their Maine home from early May and left for Tucson, Ariz., in early October. We look forward to seeing them on their return in the late spring of 1972. . . . Our faithful **Mal Baber** writes on August 17 from the S. S. *Prince George* (Alaska Cruise): "As usual, I have not much to offer in the way of news. Our tax rush this year extended pretty well into July. Now Jean and I are off for a few weeks. We flew to Seattle, then Vancouver, where we took off for a short Alaska cruise. On our return to Seattle, I was a delegate at the annual convention of the Military Order of the World Wars (MOWW). Then home and back to work. I did get back to our 55th at Yale and found there both **Bill Wyer** and **Ed Little** so the entire 1918 delegation was together again. I am trying to sell them on joining us in 1973 but so far, do not seem to make too much of an impression. (Note: Keep trying and we will help in every way we can.) That seems to be about all in the way of news I have. My regards and best wishes to you both and hope to see you soon."

A most interesting exhibit of paintings by Robert Salmon, painter of ship and shore, at the Boston Public Library, included an intriguing grouping of photographs by **Samuel Chamberlain,** showing buildings which were part of Salmon's Boston and which are still standing—Back Bay mansions, Faneuil Hall, the Bullfinch-designed Third Harrison Gray Otis House, etc.

Our mini-reunion originally scheduled for October 24 has been moved up to October 17 and will be reported in the next issue of the *Review.* I appreciate the thoughtfulness of many of you who wrote me their regrets because of their inability to be present, but I am happy to note so many are already preparing for our 55th in 1973. Typical of these responses but with a different twist is this one from **Walter Biggar.** "Dear Max, I will be unable to be with the Class of 1918 at the 'mini-reunion' this weekend. Sorry I didn't get this answer to you sooner but I'm doing a lousy job of communicating at present. Now that I've given you that decision I'm sure you will want news of what I've been doing since our 50th reunion three years ago.

"I remarried in 1969 to Mrs. Boyd Payne of Burlington, Vt., who graduated from Simmons in 1918. We decided to make our home in South Burlington. We spend our winters in Jensen Beach, Fla., about 40 miles north of Palm Beach on the east coast. We are there over five months of the winter. We vary our route to and from Florida to visit places that are interesting or visit friends we haven't seen for some time. During the summer we travel quite a bit visiting friends, relatives and children. The time passes quickly and life is never dull. Will try to make it to Cambridge next year. You're doing an outstanding job as Class Secretary. With best wishes for the 'mini-reunion'."

We are happy to report that **Julie Howe** is a recipient of a well-deserved Certificate of Appreciation from the M.I.T. Alumni Association for his efforts in behalf of the M.I.T. Alumni Fund. Keep the news items coming in to **Max Seltzer,** 60 Longwood Ave., Brookline, Mass., 02146 and **Leonard Levine,** Assistant Secretary, 519 Washington St., Brookline, Mass., 02146

19

Our loyal class agent **Dean Webster** wrote in July from New Hampshire where he was hospitalized at Phillips House. Arterial blockings were successfully removed and Dean was home and playing golf again in a few weeks. A card dated September 4 states his recovery has been slow but excellent and his golf is also coming along slowly. Dean received a Certificate of Appreciation for his work in the 1970-1971 Alumni Fund.

. . . Colonel **Bill Bassett, Jr.** commented in his last note that "the ducks and apple blossoms were late this spring." . . . **Lloyd R. Sorenson** wrote, "Winnie and I have just returned from a four-month assignment in Cartagena, Columbia, S.A., as a volunteer executive with I.E.S.C. with a Conastel shipyard assignment as a shipbuilding and ship repair consultant." . . . **Larry Riegel** and **Roy Burbank** were at Alumni Homecoming in June.

William F. Bennett passed away on May 20, 1971. . . . **George U. Parks** passed away on April 20, 1970.

Mrs. Mary M. Lee wrote of the passing of her husband **Marshall Lee** on August 5, 1971: "How grateful I am that he was able to attend the 50th reunion of his class. He was awarded the Silver Beaver for his excellent work over many years in Old Colony Council of Boy Scouts. He was with Bird and Sons, East Walpole, Mass., for 38 years as their packaging engineer. He left two sons, a married daughter and eight grandchildren. M.I.T. was always close to his heart and for the 48 years we were together, except for family and church, his years there and his associates there were his greatest source of pride. I was happy to have met so many of you good friends at the reunion."

R. B. (Bob) **MacMullin** retired as of August 1971. He was president of the First Gas Regiment (World War I) for 1971 and they conducted their 53rd reunion in Niagara Falls in October 1971. . . . St. Joseph's College (Philadelphia) conferred a Doctor of Science degree on **Harry A. Kuljian** in September 1971. He had previously received a similar honor from Drexel Institute.

We have a nice note from **Ed Moody,** Nashua, N.H. (RFD 3) 03060; he writes: "Apparently we mechanical engineers are not supposed to retire ever. My neighbors have found I can make cranky one cylinder lawn mowers and snow blowers go again so there is an unending line of them parked in my yard for tuning, overhauling, etc." . . . **Don Way** writes on August 26 from Westfield, N.J.: "Early in July Barbara and I went to New Hampshire where we have been going for 20 years or so. The lake we go to is near Bristol. While in the supermarket in Bristol we were hailed by **E. G. D. Paterson.** He and his wife have been going to New Hampton about three miles from Bristol for years."

Ken Brock, Director of the M.I.T. Alumni Fund wrote in July with copies to Don Way and Dean Webster about a fund our class raised of Victory Bonds Series F in 1944. This now amounts to $16,000 and it was suggested we bring it up to $50,000 as a target for our 55th reunion and earmark it Class of 1919 Scholarship Fund—the income to be available to needy students. Your officers endorse this plan and unless we hear to the contrary we will proceed with this plan.

Your secretary traveled across Canada and into Alaska this summer having been away from Florida from June until October. The trip was a great success and had some golf at various points along the way, Banff, B.C., Jasper, Deep River, Ontario, Chautauqua, N.Y., Westchester County, N.Y., Washington, Gaithersburg, Md., Ponte Vedra, Fla. We saw **Nelson A. Bond** at lunch in Washington in late September. He is with the Pentagon working in communications and has been to Vancouver and Anchorage recently in this work. . . . I also had lunch with **Edgar R. Smith** at the members room in the Richmond, Va. Museum on our way south on October 6. He and Grace are still having a great time at their Spring Cove farm, P.O. Box 52, Lottsburg, Va. 22511. Ren occasionally sees Al Kruse, '20, and Bud Fisher, '18 at Wilmington, Del.—**E. R. Smoley,** Secretary, 50 East Rd., Delray Beach, Fla. 33444

20

Present at the inauguration of President Wiesner were Beth and Ed Ryer, Buzz Burroughs and the Bugbee twins. The twins, I might say, are feeling mellow, both having arrived this year at their golden wedding anniversaries, Perk and Mina in May, Harold and Amy in October.

Stan Reynolds sent us the following message, "Congratulations and thanks for the invitation in October 1969 to the celebration." Nothing wrong with Stan's memory, referring to a letter written him at that time. We, too, were sorry he couldn't make the party.

George Wilson writes that he retired nine years ago as principal of the Quincy, Mass., High School, and has been pursuing his hobbies with zeal—mineralogy, ornithology, oil painting, metal detecting, and keeping house for his invalid wife, Ruth.

Clyde Hall of 928 No. Casey Key Road, Osprey, Fla., has been elected to a two-year term as president of the M.I.T. Club of Southwest Florida. He had previously served as vice president of the club. . . . **Al Glassett** is now in Pompano Beach, Fla., address 111 No. Pompano Beach Blvd.; **Ralph Larsen** is in Dover, Mass., at 45 Tubroek Dr.; **Sam Schenburg** now resides in Miami Beach, at Oceanside Plaza, 5555 Collins Ave.; **Peter Woolf** is also in Florida, at 3725 So. Ocean Dr., Hollywood.—**Harold Bugbee,** Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

It is with heavy heart that we record the passing on September 4, 1971, of **Raymond Alfred St. Laurent,** 47 Gerard Street, Manchester, Conn. 06040, beloved leader of the Class of 1921 for the entire 50 years since our graduation and the unanimous choice to continue as Class President in the 50th Reunion balloting last June.

Ray had been enjoying activities at his summer home, Saints' Haven, Vinalhaven, Maine, and was steadily gaining strength and mobility following surgery to correct an arthritic hip condition. He failed to rally from a sudden heart attack after several days in a Rockland, Maine hospital. Services were held in the Center Congregational Church, Manchester, with the Rev. Winthrop Nelson, senior minister, officiating. M.I.T. was represented by a dozen members of the Class of 1921 and their wives. Tributes came from family, business associates and a host of friends as well as from the Class of 1921 and a number of its members.

Ray St. Laurent, '21

Ray was born in Boston on March 2, 1901, and was a graduate of Boston English High School. At M.I.T., he had been general manager of *The Tech* and the founder and general manager of this country's first college technical magazine, the *Tech Engineering News.* He also was active in Osiris, Pi Delta Epsilon, Stylus, the Institute Committee, Chemical Society, Aero Club and Technique Electoral Committee. He served as delegate to several college student conferences. During World War I, he was an apprentice seaman in the S.N.T.C. at M.I.T. He was graduated with us in Course X and earned the master's degree in Course X-A the following year. He had been associated with Arthur D. Little, Inc., Boston, and the technical sales division of Standard Oil Co. of Indiana in Chicago, Ill., before joining the then Rogers Paper Manufacturing Co., Manchester, Co., in 1929. He retired from Rogers Corp., Rogers, Conn., in 1963 as vice president in charge of marketing and continued as a consultant to the firm.

He was a member of Center Congregational Church, Manchester. Other memberships included the Society of the Plastics Industry, the Technical Association of the Pulp and Paper Industry, the M.I.T. Club of Hartford, the M.I.T. Alumni Center of New York, the University Club of Hartford and the Manchester Power Squadron. For many years, he had been an Honorary Secretary of M.I.T. and, in 1969, was awarded the Bronze Beaver, the highest award of the M.I.T. Alumni Association, in recognition of his outstanding services to the Institute and its alumni. He had been named Class Secretary in our senior year and had assumed leadership of the Class of 1921 immediately after graduation, continuing as the head of the Class organization for the more than 50 years since that time. He was honored for his long service at the 50th Reunion of the Class last June and was reelected President at that time. He is survived by his wife, Mrs. Helen Mackenzie St. Laurent; two

brothers, Wilfred H. St. Laurent, Guilford, N.H., and George C. St. Laurent, Tenafly, N.J., and several nieces and nephews, one of whom is Wilfred H. St. Laurent, Jr., M.I.T. '51.

The Reverend Dr. **Williston Wirt** of our Class has sent us a stirring eulogy in which he writes, in part: "What a gallant man he was! All of us at the Reunion felt immensely proud and appreciative of his leadership, administered at such cost in effort and determination. He was indeed an inspiration. His real contribution consisted of 50 years of maintaining friendship and concern for the members of the Class. That is what makes the Class of 1921 so very unusual. Even M.I.T. Presidents seem proud to be seen in 1921 blazers and the credit belongs to Ray, whose devotion has never flagged. This interest in every member of the Class was Ray's special genius, for which we have high praise and gratitude. I hope you will convey our love and sympathy to Helen and his family. How much we now appreciate his presence at the Reunion. 'Life is ever Lord of death, and love can never lose its own.'"

For your Secretary, the loss is a severe one. We have lost our closest and oldest M.I.T. pal, in point of time. Since the first week of the freshman year, 54 years ago, we have been in constant contact with each other, both in the production of undergraduate publications and in serving as the sole officers of the Class of 1921 until formal elections at the 25th Reunion established us in the respective offices of President and Secretary-Treasurer. We shall miss a true friend and thoughtful administrator; one who genuinely valued people and enjoyed extending to them the niceties of courtesy and help in every possible way.

We sincerely thank you and all the members of the Class of 1921 for the tremendous assistance and numberless amenities which you have extended to Ray and your Secretary over these more than 50 years of serving you. Our gratitude knows no bounds.

And now, in taking leave as your Secretary-Treasurer, we bespeak for our successor, **Sumner Hayward,** your continued extension of the generous aid which you have showered upon us over the years. Maxine joins me in sincere good wishes to you and yours.—**Carole A. Clarke,** Secretary-Treasurer Emeritus, 608 Union Lane, Brielle, N.J. 08730; **Sumner Hayward,** Secretary, 224 Richards Road, Ridgewood N.J. 07450; **Edwin T. Steffian,** Assistant Secretary, Steffian, Steffian and Bradley, Inc., 19 Temple Place, Boston, Mass. 02111

22

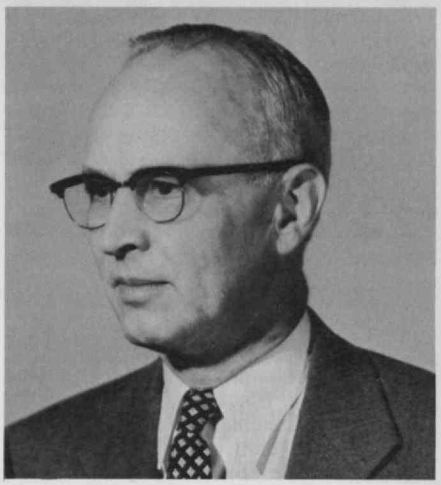
As we write these notes on a beautiful, sunny, colorful, warm Buffalo day in October, our thoughts stray toward the afternoon's golf game. Our important news is from president Parke Appel and his 50th Reunion letter. The activities planned for next June are becoming more attractive, from the hospitality on Thursday, June 1 to the farewell dinner on Monday night. We will be the featured class at Commencement and the Homecoming luncheon with entertainment and planned activities at other times. Plans will be discussed at the Union League Club in New York City the evening of November 9. Those who will participate include Sam Reynolds, Bill Meuser, Ev Vilett, and Dale Spoor. Dale and Don Carpenter have been especially active in our behalf. They are joined by Yard Chittick, Bob Tonon, Warren Ferguson and Oscar Horovitz. Don't fail to give highest priority to our 50th Reunion next June.

We noted with amusement a cartoon in the *Saturday Review* of a more mature man walking into a classroom of young people. The caption reads "It is inspiring. He came back for his 50th Reunion and simply decided to stay."

John F. Hennessy, Jr., President of Syska and Hennessy, Inc., has been elected a director of the Franklin Society Federal Savings, New York City's second largest savings and loan association. John's firm was responsible for the design of the mechanical and electrical systems in such buildings as the new Madison Square Garden, U. N. Headquarters, Rockefeller Center, Lincoln Center and the John F. Kennedy Center for the Performing Arts in Washington, D. C. He is a former director and past president of the New York Association of Consulting Engineers, a member of the Cardinal's committee of laity of the Archdiocese of New York, and president of the Board of Trustees of the Whitby School in Greenwich, Conn.

A Certificate of Appreciation by M.I.T. in behalf of the Alumni Fund has been awarded to **Dale D. Spoor.** Dale has long been one of our great M.I.T. boosters. . . . **Francis J. Laverty** has been retired for several years and lives in Rockland County, N. Y. He and **Steve Neiley** expect to see us next June. . . . **Ronald G. Macdonald** acts as senior editor of *Southern Pulp and Paper Manufacturer,* published in Atlanta, Ga. He is interested in Rotary International and attended its convention in Australia in May. . . . **Elmer E. Sanborn** received official notice confirming his world's record for running a mile at age 71. He will be with us in June. . . . **Franklin O. Rickers** is snorkeling and enjoying underwater photography while living on Jupiter Inlet, some 300 yards from the ocean. He invites us to take snorkeling lessons at high tide. . . . **Rudolf H. Blatter** celebrated his 50th anniversary by moving to Sarasota, Fla. Rudy will be at our 50th. . . . **George B. Bailey** is Director Emeritus of the John B. Pierce Foundation in New Haven, Conn. He is doing consulting work with hobbies of economics and the problems of inflation and unemployment.

Newspaper pictures, clippings and news releases by the Photographic Society of America proclaim **Oscar H. Horovitz** of Newton, Mass., one of the best nonamateur cinematographers in the world. He was given a special write-up in the *Boston Globe* telling of his world travels and popular lectures. We hope that he will entertain us at our June reunion. His latest honor reads "for his special work in the field of motion pictures and his extensive service to the motion picture



J. Russell Hemeon, '22

division of P.S.A." . . . For our various games at the reunion we have an entry, **Martha E. Munzer** of Mamaroneck, who has seven grandchildren and one great-grandchild. Her trip to Turin, Italy and lecture on "Durable Environment: Ecology and the Engineer" was an outstanding success.

Fred R. Hemeon wrote telling of the death of his father, **James Russell Hemeon** in September at Lakewood, N. J. Gus started as a research engineer with Snead and Co. and retired from the Ternstedt Division of General Motors in 1963. He was awarded many honors as developer of unique hydraulic equipment and as author and lecturer on its design, construction, operation and maintenance. He is survived by his wife Grace, a daughter, a son and nine grandchildren. . . . The sympathy of our class is extended to the families of **John E. Jackson,** Neville Island, Pittsburgh; **Daniel P. Moynihan,** Buffalo, N. Y.; **William A. Clark, 2nd,** Rockville Center, N. Y.; **Paul E. Lord,** New York City; **Jonathan Chace,** Little Compton, R. I.

Among the changes of address are: Rudolf Blatter, Sarasota, Fla; Donald F. Carpenter, Mendenhall, Pa.; Alden F. Erikson, Kerrville, Tex; Bryant Essick, Los Angeles, Cal; Fay H. Osborne, Windsor Locks, Conn; Preston Robinson, Williamstown, Ma; Conrad E. Ronneberg, Columbus, Ohio; Mrs. Frederick S. Blackall, Cumberland, R. I; Mrs. Chester W. Greening, Westport, Conn; Mrs. Fred Koch, Wichita, Kansas; Mrs. Harry E. Rockefeller, Delray Beach, Fla; Mrs. Henry M. Schley, Jacksonville, Fla; Mrs. William K. Taft, Akron, Ohio. . . . Do write more news to your starving reporter in sunny old Buffalo. So on this beautiful Indian Summer day in October—our Season's Greetings. May your days be happy, healthy and rewarding.—**Whitworth Ferguson,** Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz,** Assistant Secretary, 31 Montrose St., Newton, Mass. 02158

23

It is with deep regret that I report the passing of our Class President, **George A. Johnson,** at his home, 35 Brae Burn Rd.,

Auburndale, Mass., on October 9, 1971. George was one of our most popular, dependable and loyal classmates. His death came after a prolonged illness during which he kept in close contact with class activities. If my memory is correct he attended *all* of our class reunions. He will be missed by his many friends in the class.

In accordance with our recent class elections, our First Vice President, **Edwin C. Schmitz,** becomes our Class President and will take over the duties of class administration.

In September it was my pleasure to join **Samuel L. Williams, Lyman L. Tremaine** and Roland N. Black '24, for a delightful lunch at the Laconia Golf Course in New Hampshire. I can report that each of these men is in splendid physical condition, that each has maintained the same old fun-loving spirit and energy so characteristic of our undergraduate days. Roland, who lost his lovely wife Mary several years ago, is anticipating wedding bells in the near future. His bride-to-be is a delightful person and Roland is certainly to be congratulated on his good fortune.

Colonel **Walter E. Richards** (U.S.A.F. retired) recently returned from Falmouth, Maine, where his daughter Mrs. V. Richards Treafy was sailing in the Adams Cup Races for the Women's Sailing Championship of North America. Her boat came in fourth, out of eight crews competing in the event. . . . On July 24, a dedication ceremony of the newly acquired headquarters home of the Old Saybrook Historical Society (Conn.) was held, and I had the chance to renew acquaintanceship with **Arthur R.** (Gus) **Belyea.** Gus was in line to become president of the Old Saybrook Historical Society but his recently increased responsibilities in business precluded his accepting this assignment. Gus is a top-notch engineer in his own right. . . . **George Bricker** wrote in June that he anticipated moving permanently to South Chatham, Mass. in July. . . . A note from **Tommy Rounds** states that he and his wife are off for a trip to Ireland and England, but hope to return to this country on October 18. A belated "bon voyage" to you both.

Jack Zimmerman has retired and he and Margery are living quietly in Westport. She is busy with Red Cross, church and the Youth Museum to which he also devotes considerable time. . . . **Forrest Lange** has been on a three-week automobile trip through England, France, Germany and the Netherlands. In France he visited a farm where, as a G.I. in World War I, he had spent the first night in the barn hayloft. The front of the house was bombed out and replaced by an addition; the windmill is still there but the arms are gone. He met the same owner who was there 53 years ago. Forrey had a good time visiting castles and chateaus. . . . Boston's Museum of Science announced on August 9, 1971, the election of **Julius Adams Stratton** as a trustee of the Museum and his appointment as chairman of its Education Committee.

Chester Clarke Taylor, who was our Class President in junior year, and also chairman of our Junior Prom Committee, passed away on September 13, 1971. He was a native of Mobile, Ala., and a veteran of World War I. He is survived by his wife and two sisters.

Joseph P. Keegan, retired president of the Calderwood Baking Co. of Portland Maine, died on July 31, 1971. He is survived by his wife, the former Jane McGervey, and a sister, Catherine M. Keegan.

By this time many of you have probably received a letter dated September 1, 1971, from **Dave Skinner** concerning the forthcoming 1923 gift to M.I.T. during our 50th reunion. It is hoped that there will be wide support throughout the class for this event. Dave reports that the Class of 1917 holds the record of $897,685 for a 50th-year gift. I have heard from several classmates that Dave suffered a rather severe physical setback during the past year, but that he is now well on the road to normalcy.

Changes of address: Professor John E. Burchard, 56 Mount Vernon St., Boston, Mass. 02108; Gordon S. Crispin, 304 National Bank Bldg., South Bend, Ind. 46601; Earle A. Griswold, 47 Harborview Dr., Portsmouth, N.H. 03801; Benjamin P. Lane, Orinda, Calif. 94563; Professor Melvin C. Molstad, 19 Shady Hill Rd., Moylan, Pa. 19065; F. Robert Robinson, RD 1, Cream Hill Rd., Mendon, Vt. 05701; Henry Y. Satterlee, Davo Products Inc., 5337 Workman Mill Rd., Whittier, Calif. 90601; Ermin G. Schoeffel, 80 Andrews St., Massina, N.Y. 13662; John E. Silvasy, 80 Lake Shore Dr., Youngstown, Ohio 44511; U.A. Whitaker, AMP Inc., Box 3608, Harrisburg, Pa. 17105; Mrs. James I. Rooney, 3690 38th N.W., Washington, D.C. 20016; Mrs. Charles H. Toll, 526 Hermosa St., So. Pasedena, Calif. 91030—**James A. Pennypacker,** Assistant Secretary, Long Hill Rd., Essex, Conn. 06426

24

HO! HO! HO!—Merry Christmas! What a thought on this October day, sun shining and thermometer at 70°F. Yesterday the mail brought a 6-cent needle from the *Review* and your scribe was caught short —short of time and short of news. I can only conclude that I am afflicted with rhetorical halitosis or most of you have arthritic fingers. There was some balm in a large envelope from the Alumni Association containing news releases and we will get into that later.

In contrast to 50 years ago, many of us close to campus lack information on 'stute activities. Recently, I became aware of *Tech Talk,* an M.I.T. Community publication. For those interested in current happenings, I suggest an annual subscription at $7.50 (50 weeks mailed first class).

The big "do" this Fall was the inauguration of Dr. Wiesner. I did not attend any of the 10-day panel discussions and colloquiums, but enjoyed the concert and events on Inauguration Day. Ran into **Joe Mares, Andy Kellogg and George Knight.** Registered, but not contacted were **Luis Ferré, Don Fife, Ray Lehrer, Charles Thomas** and **Paul Tishman.**

The following day, Friday October 8, several of us attended a panel discussion on the M.I.T. Environmental Laboratory conducted by the Director, Professor Raymond F. Baddour. Present were **Jack Hennessy, Don Fife, Frank Shaw, Ed Moll** and **Maynard** (Lank) **Harris.** President Wiesner is very anxious to have this project progress and is enthusiastic about our Class 50-Year Gift in its support. Initial space has been assigned, one study (an international project) has been completed, titled "Study of Man's Impact on Climate" (S.M.I.C.) and available in reprint form or included in the text *Inadvertent Climate Modification* (M.I.T. Press $2.95). To be published soon is *The New Energy Technology* and under way is "The International Environmental Control Program" headed by Professor Michael Baram. And the fourth E-Lab project just moving is "Exploitation of Mammalian Cell Cultures in the Bioassay of Environmental Chemicals." To a civil engineer, this means, "Watch your language!," but in reality it has the potential of very quickly measuring the long-range effects of substances in their actual non-laboratory concentrations. Quotes from the October 5, 1971 *The Tech:* "M.I.T. Class of 1924 has chosen the E-Lab as recipient of its 50th Reunion Gift. They will provide for a Lab Fund, hopefully reaching a half a million dollars by 1974. Class members are also being urged to solicit gifts from industry."

In July, Professor **Sam Shulits** advised from Canada that he was heading back to the U.S.A. Early in September a card from Media, Pa., said that he is a Visiting Professor, Civil Engineering Dept., Villanova University, Villanova, Pa. 19085. New Brunswick was too far from daughter at State College, Pa., and son at West Point; also, taxes were outrunning the inflation rate. . . . Professor **John Skinkle** simply writes, "Went 'round the world this spring and used a lot of color film." Formerly at Lowell Textile Institute and a member of American Association of Textile Chemists and Colorists, John's address is now Bywater Road, Annapolis, Md. 21401. Appears that he saw the world before joining the navy.

Our distinguished classmate, **Luis Alberto Ferré,** Governor of Puerto Rico is again in the news. In May he received the 1971 Albert Einstein Commemorative Award in Human Rights "for his firm commitment to social progress and democratic rights, and for his libertarian philosophy, vision and inspired leadership which has enhanced Puerto Rico's distinction in the family of humankind." He also becomes a Founder of the College of Medicine for his very generous support "in view of the long commitment and health services given by the Albert Einstein College of Medicine to the Puerto Rican community." In July, he addressed the National Press Club in Washington, presenting facts and figures on Puerto Rico's economy, disputing recent rash headlines and commentaries in the press which gave a greatly mistaken and distorted view of Puerto Rico's situation. He admitted that there have been problems, some not yet solved, but concluded that without doubt, his Commonwealth was surging ahead on solid foundations.

We were pleased to hear that **Paul Tishman,** New York City contracting tycoon, will be chairman of the newly established

M.I.T. Council on the Arts. A fitting event, for which Paul is honorary chairman, will occur the evening of November 4 at the New York Metropolitan Museum of Art when alumni and guests will greet President and Mrs. Wiesner. Dr. Wiesner will discuss the future of the Arts at M.I.T. Apparently Paul was a child prodigy, spending only a limited time in civil engineering at the Institute, establishing his own construction business and acquiring wide recognition in the arts. . . . **Chris Conway** appears to have forsaken the New York City area for Pineville, La. Guess the bayou life got him, for in July he toured Colorado. He will take off again in October for golf at Myrtle Beach, S.C., proceeding to Moorestown, N.J. to visit his son and family. At A.T. and T., his traffic dial equipment connection should have been long distance lines. His chief relaxation is in the arts, playing his Baldwin organ—electronic, no doubt.

A September news release announced the retirement of **Gordon Harvey,** Regional Director of the Genesee State Park Commission, after 42 years of service to New York State. He has been a consultant for other agencies, including the 1939 World's Fair, Power Authority and Great Lakes Commission. He also received honors and awards from a number of organizations including the New York Association of Architects and the American Society of Civil Engineers. The Harveys will move from under the pine trees into the sunshine of Fort Lauderdale, Fla. . . . A current retiree is **H. Carlton Moore.** He will continue his association with Metcalf and Eddy Engineers as a consultant. For sixteen years he served on the Mechanical Engineering faculty at the Institute. His specialty has been in the solid wastes field where he participated in the design of over twenty large incinerator plants and authored many professional papers and articles. Dr. Moore is a member of several professional societies and pollution control associations. . . . **Bill Correale,** erstwhile New York City Commissioner of Water Supply, is spending his time at the Polytechnic Institute of Brooklyn as technical director of code projects. Certainly not a soft job for New York City with its potential skyscraper fire hazards. With his civil engineering and construction background he can contribute much to the safety of Homo sapiens in his high-rise ant hills and cliff dwellings.

Betty Kane has most generously donated Chick's entire collection of 23 steins to the Class. The officers and classmates are most grateful for this prize acquisition and have submitted a display cabinet design to the Faculty Club for approval and installation there. A real everlasting reminder of Chick's astute handiwork.

For those of you interested in balanced investing, the 1967 Study of University Endowment Funds places M.I.T. third with $396,000,000 market value after Harvard and Yale. Our conservatism is obvious with 47 per cent in common stocks, versus 57 per cent and 64 per cent respectively for the reds and blues. Bonds, cash and preferreds are 48 per cent against 38 per cent and 30 per cent. Confucius say: "He who would take loss on deflated holdings could put same in Class Gift!"—**Russell W. Ambach,** Secretary, 135 Aspinwall Ave., Brookline, Mass. 02146

25

Arthur M. Sharp writes he has retired from business and spends the winters in Florida. He is still active as Mass. Alumni Treasurer for Gamma Phi Delta Theta and has worked with this active chapter every month for the past fifty years. . . . **Alexander J. Rokicki** retired from the New York Telephone Co. in 1964 and divides his time between upstate New York in summer and Florida in winter. . . . The following from **Roger Ward:** "I have just returned from a three-month trip as a passenger on a German freighter—England, Germany, France, Belgium, Central America and the Caribbean Islands. Have enough material to continue free lance writing for a couple of years but I'm getting lazy, besides I find work as consultant for real estate development corporations more profitable and almost as interesting." . . . **Frank D. Klein** says that after a lifetime in the northeast ending with 30 years in New Jersey he finally made his wife and self very happy by moving to Ventura, Calif., which is most delightful in every way, especially the moderate climate.

It is with regret that I have to report the following deaths of members of our class: **L. Gray Marshall** of Alexandria, Va., on March 17, 1971; **Joseph P. McCarthy** of Runson, N.J., on July 4, 1971; and Professor **Hillman M. Bishop** of New York City, July 28, 1971. Professor Bishop taught political science at City College for 39 years, specializing in constitutional law. He was co-editor of *Basic Issues of American Democracy,* a college textbook first published in 1948 and now in its sixth edition.

Charles M. Cooper of Northfield, Mass., died on August 28, 1971. He was a member of the Northfield Planning Board and associate member of the Franklin County United Fund. He served on the staff at M.I.T. from 1925-1936 as research assistant and later as assistant professor and director of the School of Chemical Engineering Practice at South Brewer, Maine. He then went to the du Pont Co. as a group supervisor in Bell, Va., where he worked on the Manhattan Project. He remained with du Pont until his retirement in 1965 when he moved to Northfield where he engaged in engineering consulting. A memorial service was conducted at the Trinitarian Congregational Church in Northfield.—**E. Willard** (Will) **Gardiner,** Secretary, 53 Foster St., Cambridge, Mass. 02138

26

Since only a few of our class were able to attend the Inauguration of October 7 why don't we give you our impressions. The speeches appear on pages 14-19 of this issue. Classmates that we saw in attendance were **Jim Killian** of course, who made the introductory remarks and Kay and **Dave Shepard. Bill Sessions** was

Clint Springer, Class Secretary of 1945 and George Warren Smith, 1926 Secretary, greet President and Mrs. Wiesner at the Inaugural Reception.

sitting with the Shepards and when we talked with him he expressed his regrets for not being able to make our 45th Reunion. Ruth and **Bob Dean,** Mary and **"Pink" Salmon** and **Morris Minsk** were all present. There were other members of the Class registered at the Inauguration but we never did get to see them—they were **Don Cunningham, Robert T. Dawes, Pete Doelger, Stark Draper, George Edmonds, Austin Kelly, Jack Kimberly** and **George Leness.**

Prior to the Inauguration there were panel discussions at Kresge Auditorium which we attended. The morning panel concerned Directions of Research at M.I.T. With $60 million received for research last year mostly for defense it is a major part of the Institute's economy. Most of the discussion involved directions in which the research might be oriented in the future, depending upon availability of funds in these new directions. Most of it was over my head but the significance was not. It is heartening to see the way M.I.T. is able to adapt to the new problems. The talent is there and the desire to solve the problems that we hear so much about. Again this will be reported in the *Review* but there was one reference that interested me enough to mention it. Professor Robert Solow stated that he felt the major problem facing the economist of the future is the ability to understand the workings of the price, money and wage levels in the economy. One particular question was raised: How can the productivity of a person working in a bureaucracy be measured? It's nice to know that someone is giving thought to such problems.

We were ready to join the *Technology Review* staff for a glass of sherry after this and since the gathering was in the penthouse atop McCormick Hall we can tell you about that too. Mrs. Ann McCormick graduated from M.I.T. in the very year many of us in '26 were born—1904. Always a devoted alumna, she decided a few years ago that the gals at M.I.T. were not getting a fair shake and should have their own dorm. Did she change things! What a posh building went up and then when it was finished she decided to duplicate it and another went up adjoining the first. Now the gals far outdo the men even to having all the fancy furniture from Mrs. McCormick's estates. But the part we saw most was the glassed

penthouse with its unsurpassed view of Boston.

You know there is talk of at least part of our 50th Reunion being held on campus and if we ended up in McCormick Hall it wouldn't be too hard to take. But back to the Inauguration—we frankly didn't spend much time at the afternoon panel which concerned Directions of Education at M.I.T. in the '70s. We were happy to leave it in the hands of the panel. Let's get to the Inauguration, which, at President Jerome Wiesner's request, was without pomp—and what a relief. No caps, no gowns, no feathers, no parade of professors and visiting dignitaries. Chairman Howard Johnson presided. Before the ceremony the M.I.T. band, situated to the right of the stage, played beautifully while to the left, the brass ensemble played, producing a sort of super-stereo effect. Both joined into one larger band as the 4:30 hour approached. The appearance and quality of that band was something to hearten old grads like us, as was the entire Inauguration. I need not tell you that Jim's introduction was in his usual polished style—nor need I tell you what Dr. Wiesner said, for you can read it in detail in the *Review.* I can tell you however that M.I.T. has done it again in selecting a man for the times. Just as Howard Johnson proved so deft at handling crises, it is evident that we now have a man willing and able to chart the course for the problems facing M.I.T. in the '70s, not the least of which is financial. He was characterized in a poem composed and read by Archibald MacLeish which is published on page 13. I have made so many references that I may have you fumbling all through the *Review* but all I really wanted to report was that it was a grand and simple ceremony. So saying Merry Christmas I'll add Cheerio until January.—**George Warren Smith,** P.O. Box 506, Pigeon Cove, Mass. 01966

27

In the notes of July/August, I made reference to the unlikely question of how bald **Sid Badger** was in 1942. Sid picked this up and has written us of much more interesting things about himself: "Quite a coincidence. I turned the current *Technology Review,* as usual, over to the manager of corporate reliability at Beckman Instruments, where I work a day a week as corporate metallurgical consultant, and he said how come I was never mentioned in your class notes. So I turned to them and there was my name as big as life! The hairline has receded a little, there is a bare spot on top and it is partially gray—but there is still plenty of it.

"I took early retirement from Haynes Stellite division of Union Carbide in 1962 after 28 years, the last 18 as vice president and technical director. I went on inactive status for four more years moving to Los Angeles as manager of materials and processes for one of Stellite's best customers, Rocketdyne division of North American Aviation. After three years, I had some very successful major surgery and retired for six months. Then started consulting for Beckman Instruments on a day-a-week basis, first at Palo Alto where I saw Alden Reed, and the last four years at corporate headquarters at Fullerton. Beckman got me started as an expert legal technical witness on metallurgical failures and I average about three cases a year. Fascinating work with excellent results to date, thanks in part to Ralph Nader. My children moved out here also, so we are all in the area. We enjoy a large garden and swimming pool. We got by the fires, floods and earthquake, but do get a few smoggy days a year at our end of the San Fernando Valley. I play golf once a week with other retired cronies. We enjoy our two grandchildren several times a month and also have my ninety-four-year-old mother-in-law living with us, so altogether we are kept jumping and look forward one of these days to some travelling. I have seen **Bud Gillies** several times and been in touch with him and **Bill Payne** by letter. Bill retired October 1 having sold his fabrics business to Mead Co. at Dayton and gradually eased off by greatly expanding his plant, if you call that easing off. Bud is consulting but primarily is chairman of Spectral Dynamics, an expanding electronics firm specializing in vibration analysis. As a sideline, I have just co-authored a paper, 'An Annotated List of the Butterflies of Indiana 1971', submitted to the Transactions of the Lepidopterists Society, but I am not collecting anymore. I always enjoy the class notes except this time I almost missed them so am glad you prodded me into this resumé." Thus ends a report to bring joy to the secretary. Sid's address is 5200 Armida Dr., Woodland Hills, Calif. 91364.

George Houston has again written interestingly: "I retired from Northeastern University in June. We have bought and are remodeling our new home at 124 Bay View St., Camden, Maine 04843. A nice little one-story ranch on a one-half-acre wooded lot overlooking Camden Harbor. Ruth and **Joe Burley** called in a little while ago; they were marooned in Rockport Harbor. We had dinner in Camden and we showed them our house. They'd like to move this way, too. We will live in our summer cottage waiting for carpenters, plumbers, electricians, painters and paperhangers to get our Camden house ready to settle. So, hopefully, we'll be back to normal living by October. It was good to see the Lyles, Hibberts, Burleys, Taggarts et al at the Class Day lunch. So pleased to meet Dike's new bride. I was so glad that we were able to persuade Betty Jackson to come to the dinner, too. We're looking forward to some interesting and productive years ahead. See you at the 45th."

I often get a complaint from **Erik Hofman** that he is referred to too often in these notes. This is modest of him but Erik often writes something interesting, to wit: "A British edition (of his book *The Steam Yachts—An Era of Elegance*) is due in October in time for the Christmas rush there. For the limited audience it commands, it has had a good sale. I have had a nice letter from the owner of 'Dixie II' who still uses her daily on Lake Erie. She was the fastest motor-boat in the world in 1908." . . . At 65, **Ted Ordman** has no plans for retirement from Kenyon and Kenyon Reilly Carr and Chapman, patent attorneys in New York. . . . After 41 years with Eastman Kodak, **Pete DePaolis** retired and bought a retirement home in Glendale, Calif., near his children and grandchildren. Referring to the Institute's part in his career, Pete has written: "My technology training was a great help in my 17 years of research and development work, and in developing and operating optical glass plants."

In December 1970, **Howard Page** ended a distinguished career with the Standard Oil Company (New Jersey) as executive vice president and director. His continuing activities include Chairman of the board of trustees of American University of Beirut, trustee of Near East Foundation. He and his wife are planning to continue their extensive travelling. . . . The man who gave his class ring to Professor Woodruff, **Francis Burke,** continues to enjoy his great hobby of travel. This year Mexico and Guatemala. He found great growth and progress in Mexico, including a superb new subway in Mexico City. This winter to India and Ceylon. . . . **Dike Arnold** reports a great time on his honeymoon in Hawaii.

A gift has been given to the Institute in memory of **William Hart Nichols** who died in 1966. . . . Reading the July/August notes, **Wes Meytrott** saw that they contained what he refers to as a "plaintive appeal for news." It is true that I was at the bottom of the barrel. So I was glad to get word from Wes about two more events in his retirement career: Wes has now concluded his job as chairman of the Search Committee to find a new president for the New York State University's Downstate Medical Center. The mission was successfully completed when Dr. Calvin H. Plimpton, who had been president of Amherst College, accepted the invitation. Wes is also heading up the Brooklyn division of the United Hospital Fund 1971 campaign. He is really well occupied.

Dick Hawkins has been awarded another Certificate of Appreciation. This time for his work in the 1971 Alumni Fund. Dick's work as the 1927 Class Agent has been outstanding. Our class percentage participation in the Fund was 53 per cent, which was as good as the best in the category of classes 26 to 49 years graduated. I'm sure that Dick would want me to add that we must not become complacent! . . . **Sam Auchincloss** has reported an address in Englewood, Fla., but I do not know whether this indicates a move from his basic home at Mechanicsburg, Pa. . . . We now have **Bud Fisher's** new permanent home address in Duxbury: 62 Goose Point Lane. . . . **Charles Pope** was last reported heading for the west coast for six months. He will be at 967 Sutter St., San Francisco. . . . **Bob Wallace's** new permanent home address in St. Charles, Ill., is 31-A Park Shore Apts., 1100 Geneva Rd.

Just as we were concluding these notes, we learned of the death of **Nelson O. Clark** on July 30. Nelson, a Texan by birth, came to M.I.T. from Texarkana, Ark. High school in 1922. He was at the Institute through 1925, then held various

engineering positions with Allan Engineering Co. of Dallas, Minneapolis-Honeywell, Raytheon, Holtzer-Cabot Electric, was a consulting engineer 1944-48, and subsequently chief electrical and development engineer for Eastern Electric Inc. of New Bedford, Mass. In 1967, we had word that Nelson had moved to Harrison, Ark. which he called "the least polluted area of the Ozarks." Shortly thereafter, we learned that he had been slowed down by a bad heart valve. It can only be assumed that this was the cause of his death. Our condolences go to his widow and family.—**Joseph S. Harris,** Secretary, Box 654, Masons Island, Mystic, Conn. 06355

E. B. Farmer, '29

R. Hawkins, '27

Elisha Gray, 2nd, '28, in front of the new research center named in his honor.

28

We were much more than pleased to have a letter from **William P. Rothwell** who heads a very successful firm of management consultants, William P. Rothwell Associates in Hancock, Mass., providing services in both the United States and in Canada. Bill has not written us before nor has he visited the Institute since graduation. This appears to have been related to some unfortunate incident of friction during his closing days as a student. Now he writes: "Time is a healer of all hurt feelings! Best wishes and kindest personal regards to all." Bill, many thanks for writing and we sincerely hope you can make it to the next reunion.

Jim Donovan's brother Andrew, who lived in Ireland, died unexpectedly in early October. This necessitated an overseas trip for Jim and Frannie at very short notice. An expression of sympathy from the class was sent to the Donovan family here. . . . **Kenneth Mackenzie** has been retired from Eastman Kodak Co. for four years now and is still living in Rochester where he plans to stay. He and Josephine take a six-week vacation every spring. Last spring they visited Italy and southern France. Ken says he must take it a bit easy because of an angina condition, however, he is still able to drive his own car. . . . Your secretary was very pleased to have an afternoon visit at home from **Bob Proctor.** This was on a pleasant day in October. Bob had just retired from Weyerhauser Company in Fitchburg, Mass. He has been engaged in the paper industry (all phases) throughout his professional life and now plans to work as an independent consultant. During the visit it developed that Bob has a latent talent as a pianist. This led to our generating some sonic radiations with violin and piano—the resultant harmony achieving varying degrees of success.

A news release from Whirlpool Corp., Benton Harbor, Mich., announces that "Whirlpool Corporation has named its research center the **Elisha Gray** II Research and Engineering Center in honor of its chairman of the board who retires September 30, 1971." One of the two plaques marking the occasion reads "Dedicated in grateful recognition of the uniquely creative, responsible, and endlessly energetic leadership he has given to the Whirlpool Corporation, the appliance industry, and the broader community." The center, containing 130,000 square feet of ideal laboratory space for over 200 scientists, engineers, and technicians, was specifically designed for research and development relating to home appliances and electronic home entertainment products. After graduation Bud went to work for Sears Roebuck and Co. Then he became vice president and general manager of Cutler Shoe Company in Chicago. He joined Whirlpool in 1938 where he was elected vice president in 1940, a director in 1943, executive vice president in 1947, president in 1949, and chairman of the board of directors in 1958. During his 33-year career with Whirlpool the company grew from a small manufacturing plant with 5.5 million dollars in annual sales to one of the world's largest producers and marketers of home appliances with sales in 1970 of almost 1.2 billion dollars. Along with many other high honors and appointments, Bud serves as a member of the governing board of the M.I.T. Corporation.

A release from the Alumni Office lists the names of 104 alumni recognized for outstanding effort in the 1971 Alumni Fund. Three of our classmates received Certificates of Appreciation: **Arch Archibald,** as a retiring member of the Fund board; **Carney Goldberg,** as a leadership gifts chairman for Boston; and **Charlie Worthen** as our class agent. In his class letter **Jim Donovan** emphasized the importance of supporting the Alumni Fund. As a class we do well in per cent of members that participate but we could do considerably better in total giving as compared with other classes. A significant improvement can be made if each of us will try to increase his contribution this year. There are some alumni who work very hard to make the Fund a success. Most of us need only exercise a little generosity.

It is hard to believe that the time for our 45th class reunion is fast approaching. Your planning committee is at work already. **Dick Rubin** has agreed to serve as chairman and he is making appointments and job assignments to the various functional subcommittees. In July a delegation consisting of Frannie and Jim Donovan, Florence Jope, and your secretary with the assistance of Wally Gale '29, made an inspection visit to the Bald Peak Colony Club at Melvin Village, N.H. This is the spot selected for the occasion on the weekend of June 1, 2, and 3, 1973. The club facility is nothing short of fabulous! Located amid the most beautiful New England scenery and on the shores of Lake Winnipesaukee, the buildings and grounds are just about perfect for a weekend of relaxation, fun and pleasure. The first meeting of the reunion planning committee was held at the M.I.T. Faculty Club on October 8. Those attending were: Maury Beren, Jack Chamberlain, Carl Feldman, Priscilla and Roger Haven, Florence Jope, Tom Larson, Mary Nichols, Dave Olken, Dick Rubin, Walter Smith, Herb Swartz, and Abe Woolf. The Havens drove all the way from Fryeburg, Maine to participate, then drove back home that same evening.

We regret to report the deaths of two classmates. **Edward S. Thompson** died February 25, 1971. Our most recent information shows that he was living in San Diego, Calif., and retired after a career of 39 years with General Electric Co. He leaves his wife Elizabeth and two children.

Charles E. Hemminger died July 19, 1971, as a result of cancer. He had been several years retired from ESSO Research and Engineering Co., where he was chief scientific advisor. More recently he worked as an independent consultant. He leaves his wife Florence, two children and three grandchildren.

Appropriate to the time you will be reading this, may we wish all of you a happy holiday season!—**Walter J. Smith,** Secretary, 209 Waverly Street, Arlington, Mass. 02174

29

I deeply regret to announce that **Edward Farmer** of Waban, Mass., Treasurer of our Class and one of the most active and diligent workers in Class and M.I.T. affairs, passed away suddenly on Sunday evening, August 29, 1971 while visiting the **Wally Gales** in New Hampshire in company with wife, Helen Clare, May and **Frank Mead** and Fran and **Paul Donahue.** Funeral services were held at the Union Church in Waban and several Twenty-niners, the Wally Gales, Frank Meads, Paul Donahues and your Secretary were present to pay their respect and bid him farewell.

Following his graduation in 1929, Ed was employed by General Electric Co. for one year and he returned to M.I.T. the following year for his S.M. in electrical engineering which he received in 1931. During the 1930's Ed taught mathematics in St. Johnsbury Academy in Vermont, employed as an electrical engineer by the Electrolux Corp. in New York and Kerite Insulated Wire and Cable Co. in Connecticut. He moved to Waban in 1943

to become chief engineer at General Control Co. In 1949, he founded Farmer Electric Co. using the basement of his home as headquarters. Having considerable success, he moved his company to larger quarters in Newton Lower Falls under the name of Farmer Electric Products Co., Inc. In 1961 the company expanded and moved to Tech Circle in Natick where it had great success and finally became a wholly-owned subsidiary of American Cyanamid. Ed remained president of the company from its inception to his sudden death. He is survived by his second wife Helen Clare, (his first wife Clara, well known to many Twenty-niners, died in 1966), and a son John M. and two grandchildren, Scott and Tamara. Aside from M.I.T. Alumni activities, he was active in the Union church in Waban, a member of Waban Neighborhood Club, Brae Burn Country Club and Rockport Country Club.

Joseph Green, Belmont, Mass., writes "I am scheduled to retire on September 1, 1972. If it were not for the fact that two of my youngest children are in college, I would resume traveling upon my retirement. The way it looks now, I would have to wait for a little while." . . . **John D. Newman, Jr.,** Zepherhills, Fla., says in his note "I retired in 1960 as sales manager from New York Telephone Co. Since then, I have been enjoying the good life and keeping my good health. We have a small winter home in Florida and a summer place in Hendersonville, N.C. so we can pick our climate. It has been a long time since we have been at M.I.T. or Boston. Rumor has it we wouldn't recognize either place. I doubt if I shall ever forget M.I.T.'s dome. Best wishes to the classes 1929 and 1927."

Charles M. Broderick, of Jamaica Plain, Mass., writes that he has just retired as director of the Museum of Transportation of Brookline. Presently, he is a consultant to the Broderick Gallery on the conservation and restoration of oil paintings. . . . Mrs. **Ruth M. Smith,** of Salt Lake City, Utah, writes that she has retired but she is just as active as ever, devoting her time to the American Association of Retired Persons, helping in the education of three grandsons (two in college), active in the Woman's Republican Party, working in every campaign. She has also managed to get a master's degree from the University of Michigan.

G. J. Guthrie Nicholson of Portsmouth, R. I., writes "the newest thing with me is our Class Secretary sending a Happy Birthday card for my birthday which is also our anniversary date. I have never slipped up on the latter yet for 38 years. Getting a card for one's own birthday helps in my case. For some 21 years I was with Con Edison, once given the dubious distinction of being experts in blackouts, and with the local utility company at Newport, R.I. For the past 17 years, I have been with the U.S.N. (now retired). I still find the electric business as much fun as when I first got interested some 55 years ago. Congratulations for being such an efficient Secretary."

Carl W. Harris of Sarasota, Fla., writes, "thanks for the birthday card. It has been 42 years since we graduated. Except for the past few years, I have regularly contributed to the Alumni Fund since W.W.II. I have had a change of heart due to my disgust at the bigotry of the faculty. Item: Rostow was not permitted to return to his professorship, yet a person like Ellsberg is placed on the faculty. I believe in academic freedom. Personally, there is nothing new. I am older, more limited physically and more grandchildren—latest count is nine." . . . **Maurice E. Barker** of Fayetteville, Ark. has retired from the U.S. Army as a colonel in 1948. Presently he is Professor Emeritus, Chemical Engineering, University of Arkansas. He does a little consulting engineering and devotes some time to writing. In recent years, he has written over 25 articles which appeared in national magazines, including *Scientific American.* He has also published a book titled *The Changing Seasons* and is rewriting another novel to be titled *The Ravaged Earth.* He has lived in Fayetteville since 1948 with his wife Katherine.

George E. White of Naples, Fla., writes, "Happily retired with permanent residence in Naples. I still love golf, fishing, cruising and loafing. Wife, Olive is also well and is enjoying Florida. Best regards to all." . . . **William Baumrucker** of Marblehead, Mass., who is our vice president, has sent me the following note after receiving a birthday greeting from your secretary (something new we started in August). "Thanks for the card! Looks like a great idea to get news for the *Review* as well as being a nice guy. Other than reaching 65, there is nothing really new with me. Still plugging along—no retirement plan yet. I am enjoying sailing and playing tennis. When I get old enough, I'll take up golf." Bill is senior vice president of Charles T. Main, Inc. of Boston, Mass. . . . **Joseph L. Speyer** of Newton, Mass., announces the arrival of a grandson, Gavriel, born to his son Jason Lee, class of '60 with a Ph.D. from Harvard. He is currently lecturing at M.I.T. . . . **Edward B. Papenfus** of Vancouver, B.C., writes, "Professionally, I am retired though still active at director level. All my family are well. Children are launched into the outside world, and Gwen and I are back where we started in 1937—alone."

Hiram A. Lyke, Oconomowoc, Wisc., has been retired for the past ten years. His hobbies are traveling, hunting, fishing and watercolor painting. He and his wife Jean have just returned from a sketching trip to Portugal, France and Ireland. They have three children and 11 grandchildren. . . . **Wilmer L. Barrow** (Zike) of Sarasota, Fla., writes, "I have been retired since October 1968. We spend winters in Florida and summers at Mirror Lake, N.H. We also do a little traveling and are enjoying our happy retirement.

Norman M. Wickstand of Harwinton, Conn., writes, "I have been retired since September 1, 1970. I will be a part-time math instructor at University of Connecticut this fall. I also do substitute teaching in several area high schools. For recreation, I spend considerable time with the Audubon Society and other conservation activities. My chief interest is in botany, not birds. A few years ago, I met **Newell Mitchell** and we discovered that we took a course in geology together under Dr. Skinner." . . . **Hugo P. Rush** of Manchester, Vt., writes, "Retired from the air force in 1951 as a major general. Served as executive director, Sports Car Club of America from 1957-62. Presently we live six months a year in Florida and six months in Vermont, having the best of both. We travel extensively by freighters and recently returned from such a trip: New Orleans to Bangkok, by air to Hong Kong, Okinawa, Japan and Vancouver. On Okinawa, we revisited our former home. Thence by train across Canada to Montreal and by bus to Manchester, Vt."

J. R. (Russ) Clark of Dallas, Texas, writes "Dot and I went to the annual M.I.T. Club of Mexico City Fiesta in March—our third. Those who have not been to one of these social-educational and good times-fiestas are missing an opportunity for a real vacation and fun. Personally I am so busy I don't have enough hours in a week to do all that I have to do. This year, I commute every week—like a suburbanite—from big "D" to Washington, D.C., giving an average of three days a week to U.S. Congress as chairman of Major Systems Acquisitions and group of commission on government procurement and two days average to my position in L.T.V., Aerospace. I am also a visiting committee member at the school of Aero and Astro at M.I.T., member U.S.A.F. Scientific Advisory Board, member technical board S.A.E., member Technical Council A.J.A., member A.I.A.A. Corporate Advisory Board. In my leisure time I play some golf. My general concern is to get public understanding that our U.S.A. can only continue to remain prosperous in international economic competition by realizing the benefits of the prudent use of sciences and technology." Russ will also be honored by his election as a Fellow of A.I.A.A. at their seventh annual meeting, October 19-22, for "his contributions to the development of naval aircraft and, more recently, the development of the V/S.T.O.L." Many thanks to those who responded with news items after getting a "Birthday Card." It makes the secretary's job much easier. Merry Christmas to you all.—**Karnig S. Dinjian,** Secretary, 32 Oldham Rd., Arlington, Mass. 02174

30

Your Secretary's plea in the July issue that our retirees provide a little more information than the bare fact that they have retired seems to have achieved a modicum of success, using this month's returns as a criterion. . . . **Frank Burley** retired as manager of engineering of Western Electric in 1968 and has developed a second career of impressive dimensions. He is Assistant Dean of Continuing Education for Purdue in Indianapolis, in which position he administers adult courses in "personal development, cultural, women's, business, vocational, supervision and engineering." Last year he programmed 200 courses with over 5,000 enrollees. He is also current president of the M.I.T. Club of Indiana and a director of the Work Release Center. The Burleys have a married daughter, Barbara, whose husband is assigned to the

U.S. Consulate in Istanbul, and a married son, Charles, who is a Viet Nam veteran and works for G.M.'s Overseas Division in Peekskill, N.Y. . . . **Charles Gale** retired as manager of publications and advertising of American Oil Company in 1968 and is now living in Oak Park, Ill. It seems that the Gale family were early settlers in Oak Park, arriving there in 1833. Because of his family's early association with Oak Park, he became interested in investigating its history. He conducted a survey of 600 old families in the area and received 295 replies, which he says is a much better response rate than he achieved in the advertising business (incidentally also better than your secretary's response rate). As a consequence of these efforts he is now president of the Oak Park and River Forest Historical Society. . . . **Bob Rypinski** retired in December 1970 and reports, "living happily ever after. Periodicals, tape recorders and books occupy a lot of my time. Otherwise, I am enjoying life with my wife, two dogs and a cat."

Henry Addison retired November 1, 1970 as chief chemist of Chart Pak, Inc. He has completed 25 years of service to the Boy Scouts and recently received the Silver Beaver award for his services to scouting. . . . **Al Deyarmond** retired from General Electric as of March 1, 1971. He is continuing to do a little part-time consulting work in the aerospace engineering field. . . . **Arthur Wildes** retired July 1, 1971 as principal of the Utica Free Academy, a public secondary school with more than 3,000 students. He plans to travel in the winter and garden in the summer. . . . **Elroy Webber** has been made Chairman of the Department of Architecture at Ohio University. However, he still plans to continue to some extent his private architectural practice. . . . **Horace Myers** reports that he is "still active in business world but on reduced basis." According to my records Horace's "business world" in 1968 was Atlas Electric Supplies in Tampa, Fla.

Supplementing the brief note on **Charles Maskell**'s death in the July issue, according to a clipping he had retired in 1968 after 34 years as an architect for the Army Corps of Engineers. Prior to that he had worked for the Treasury Department, G.S.A., and the Veterans Administration. . . . As previously reported in the Notes, **Charley Dwight** is vice president and treasurer of the University of Hartford. From a newsclip we have at hand it appears that he has now taken on the additional job of treasurer of the University Research Institute of Connecticut in Wallingford.

Changes of address: Reverend V. I. Thormin, R. R. #1, Kingsbury, P.Q., Canada; Colonel Angelo M. Ricciardelli, 28 West Leigh Dr., Charlottesville, Va.; John M. Cleary, 1000 Wiedman Road, Manchester, Mo. 63011; Edward A. Harrs, High Ridge, Mo. 63049; Langley W. Isom, c/o General Delivery, Rockland, Maine 04841; Earl L. Krall, 63 Chester Circle, New Brunswick, N. J. 08901; John Lovejoy, 715 51st St., Des Moines, Iowa 50312; William W. McDowell, 1838 Hurrican Harbour Lane, Naples, Fla. 33940; Henry M. Nelly, Jr., 5160 N. 83rd St., Scottsdale, Ariz. 85253.—**Gordon K. Lister,** Secretary, 530 Fifth Ave., New York

32

The 40th reunion of members of the Class and their wives will be held next June. You will be receiving detailed information by direct mail as your Reunion Committee concludes arrangements. **Ed Nealand** is chairman and has held meetings to plan activities and arrive at a schedule. We will be housed on campus in one of the newer dormitories. Reunion activities will begin with registration and cocktails on Friday evening, June 2 and carry through to Sunday evening when Alumni Homecoming activities begin with a buffet followed by the Boston Pops. Alumni Day, Monday, June 5, will include luncheon ceremonies at which our 40th reunion class gift will be presented to M.I.T. Bob Semple and his committee will contact every member of the class in the effort to make this gift a generous one. Start planning now to come to the 40th in June.

Richard A. Lobban has retired from the Picker Corp. after 38 years of service. He now divides his time between Newfound Lake, N.H., and Devon, Pa., where he is involved in numerous church and civic activities. . . . **Alva T. Wilson** writes that he became a victim of defense cutbacks after 24 years with Atlantic Research, West Hanover, Mass. He purchased a beat-up and run-down package and variety store in Green Harbor (Marshfield), Mass. After one year's operation he says he is fortunate that his wife is gainfully employed as a secretary. . . . **Jacob Millman,** recipient of the 1970 Educational Medal of the I.E.E.E. has his sixth textbook, *Electronics: Analog and Digital Integrated Circuits* (with C. Halkias) now in press.

I picked up the following information from an undergraduate now at M.I.T.: Michael Charette, Class of 1974, has broken the varsity javelin record. The record was set by **John Robertson** in 1931 and has not been broken for 40 years. That's quite a record.—**Elwood W. Schafer,** Secretary, M.I.T. Room 13-2145; **James Harper,** Assistant Secretary, 2700 So. Grant St., Arlington, Va.

33

We are off and running on our last contribution of the calendar year. With only three personal notes, I am suitably discouraged. However, the Alumni Fund capsules really do save my scrivener's life, and I have a bundle of these. A fine letter from **John Longley,** mentions his long association with **John W. Campbell, Jr.,** deceased earlier this year. They went to high school together and then both went on to M.I.T. John keeps busy: plays a little golf with astoundingly high scores (as who don't?), keeps busy around the house converting a sleeping porch into an art studio and installing a suspended ceiling in his basement billiard room. Many thanks, John, for your being so nice to write us.

Guido (Garby) **Garbarino** spent two months in Poland, Roumania, U.S.S.R., and East Germany, so, he missed the festive Alumni Day with some sorrow, and also a N.Y.C. meeting where John Wiley had arranged a chance for the boys to meet Dr. Wiesner. Inasmuch as Mary was packing his bag as he wrote, Garb was a bit brief, but, as always the faithful friend. Thanks indeed, Garby. . . . The most faithful of all, **Cal Mohr,** sends the following news. **Otto Putnam** has been in Germany as a consultant for a chemical plant. **Adam Sysko** is still hammering away at du Pont, and is in fine health. Cal himself is retiring president of the Chicago Section of the Filtration Society. The society is planning an April symposium on "The Control of Industrial Pollution," with speakers from the U.S., Canada and England. Cal could not attend the 40th reunion meeting October 6, and asks for information on what happened. Our good president, **Jim Turner,** has sent out a report on the meeting which included **Ellis Littmann**'s report of progress to date. We have reached a figure somewhat less than the $660,000 we are shooting for, but in line with Ken Brock's experience, our present figure is about on a par with progress made by previous 40th funds with approximately one and one-half years to go to reach the final goal. This is satisfactory, but surely not inspiring. Never fear, fellas, we are going to hit the 660 or else. You can be sure that a program heading for final success is definitely on the roll. Nine class officers attended this meeting, seven of them from outside the greater Boston area. In the order of distance travelled: Clarence Westaway, George Stoll, Fred Murphy, Jim Turner, George Henning, Dayton Clewell, Bob White, Ellis Littmann, and yours truly. It was an excellent lunch, a very congenial group, and a pleasure to meet and visit with old friends.

Now for the Alumni Fund capsules: **Prentiss Huddleston,** President of Huddleston, Satterfield, Evena, and Lillie, Architects and Engineers, of Tallahassee, Fla., writes briefly and only that. Gee, that sure is brief. . . . From **John C. King** of Cleveland we hear about the forthcoming national meeting of the American Society of Civil Engineers, April 27-8, 1972. John is program chairman, and says that the assembly of technical papers for five concurrent sessions is no joke. John calls this extracurricular. So it is, and a labor of love or I miss my guess. . . . Another is from **Peter Parker,** who has just retired from the Kolar Labs of Chicago, where he has been chief chemist for many years, and 31 years with Kolar. The Parkers have just bought an old house, in good repair but singularly lacking in modern conveniences. Pete is remodelling the house, and expects to keep busy for a very long time.

Sulo E. Paananen, an aero, writes us from Buffalo that he is manager of marketing information at Bell Aerospace Co. He has one daughter teaching, and a son just graduated from Buffalo State. Both Sulo and his good wife are (it says here) getting older, but are enjoying good health. Well, Sulo, you have two theoretical choices, get old or the other. Keep on getting old! And, thanks for your thoughtfulness. . . . Now comes a quickie from **Warren Webster,** who announces ever so briefly that he has re-

tired and is teaching, mostly math. Warren sends his best to Leona and me, and says that he appreciates the 1933 notes. Thanks, Warren. . . . I have a capsule from **Outerbridge Horsey,** who sums up his career on his retirement thus: 33 years in the U.S. Foreign Service, Italy, Japan, Hungary, Spain, Portugal, Czechoslovakia and intervals in Washington, Department of State. He was Ambassador to Czechoslovakia 1963 to 1966. . . . Now comes **John E. Logan;** last known activity was as vice president of Jersey Central Power and Light. Now, he retires. Golly, soon nobody will be working. Heck I remember when I was the only one retired, but that was in 1948 (no fooling). John is moving, to Boca Raton, Fla., just ten minutes away from 1079 Hillsboro Beach. Thanks, John and I await your personal call on me.

For the first time ever, we have a note from **Kenneth A. H. Smith,** consultant on the technical staff, Naval Security Engineering Facility. He has just returned from an extensive seven-month trip for the navy, to England, Scotland, Belgium, the Netherlands, Italy, Norway and France. He says, "That is too long for a bachelor to live out of a suitcase, on a great trip, but too long from the good old U.S.A." A bachelor yet; say, fellows, I must ask for a list of bachelors. Will all bachelors drop me a line stating the case for single blessedness? . . . From **Al Payne** comes the shortest missive I have had in five years, dateline St. Louis. "Remarried 9/26/71 to Elizabeth Sorrells." Now Al, I ask you, for the love of Mike! Last time I saw you was our little St. Louis dinner three or four years ago. You just gotta tell us more. . . . **Samuel F. Allison,** Commander, Chemist, and Lawyer in Norfolk, Va., specializes in patents, trademarks and admiralty. Such brevity is amazing, but Sam, I still appreciate what little I get. Thanks.

Changes of address have accumulated since last May: Wendell C. Allen, MA (CE); Edward J. Bertozzi, CH; Charles J. Cirame, MA; Gorham Cluett, MG; Julio De La Fuente, ME; Albert Goldberg, AA; Sam B. Goldstein, AA; Herbert Grundman, CE; John G. Hayes, EE; Leon Hyzen, AR; Robert A. Keyser, ME; Paul C. Koether, GE; Frank M. La Bouisse, AR; Lawrence C. LeBeau, CE; John E. Logan, EE; Norman D. Loud, CH; W. Elton Merritt, CE; Maxwell D. V. Millard, EE; Edward S. Rowell, CE; Elbert J. Sieber, ME; Peter A. Sorrentino, EE; Donald A. Thompson, AA; Charles F. Van De Water, GE. Anyone needing any of these addresses, has only to write the secretary, include a short but good biographical sketch, and the job is all done. I will reply with pleasure. We have addresses for these widows of two deceased classmates: Mrs. Morris Green, and Mrs. George Newman. I have them both for anyone, without the biog.

Many important events have taken place since last we had a chance to report; the 40th reunion committee meeting already reported, the first meeting of the school year of the Alumni Advisory Council, and the Inauguration of Jerome (Jerry) Wiesner as President of M.I.T. The alumni council meeting was well attended; speakers were Dr. Wiesner, and Dr. Paul Gray, the new Chancellor. They both spoke briefly and generously replied to many questions from the floor. This was my first time to meet Dr. Gray and I was very much impressed. My high regard for Dr. Wiesner was reinforced; he too promises to be a top notcher. The simple inaugural was a part of Dr. Wiesner's plan to get the job done with far less expensive fanfare than is usual in these cases. I attended the Inauguration and enjoyed every minute; I even brought my hearing aid to be sure of getting part of the speaches. (*For a full report see pages 13-19 and 81-85, this issue.*)

Listed as registering for the Inaugural Events were: William E. Barbour, Jr., Dr. Dayton H. Clewell, Arthur S. Hayden, W. J. H., Ellis C. Littmann, James E. Turner, Clarence R. Westaway, and John R. Wiley.

Send in your news as fully as you please; we will do the editing. To those who have never written at all, I must confess, your motives are not clear. To those who have written in the past, what has happened? Have I or the staff displeased you? I'd say, if so, gripe, but do something. Every man jack of you is under an obligation to keep the secretary informed. Won't you cooperate?

This issue will reach the faithful just before Christmas, so Leona and I ask for you a very merry Christmas, and the usual happy New Year. Most will agree that we have a lot for which to be thankful, as this year ends and a new one starts. 1972 will be a great year for one real reason; it will immediately precede the 1973 40th reunion, of which you have been reminded before. Please make plans way ahead, and don't look around for something else to do for early June, 1973. One further change of address: mine. I will be at 1079 Hillsboro Beach, starting about November 20. Newcomers like Logan might well take time to look me up, say around 5 p.m. That's when the smart ones drop in for some reason or other. Again the best to all of you, from Leona and me.—**Warren J. Henderson,** Secretary, Fort Rock Farm, Drawer H, Exeter, N.H. 03833

34

Just now I feel like one of the "good guys" from that child's morality story about the grasshopper who fiddled while the squirrels stored away nuts. The input has been light this month so I've unearthed some of the nuggets I squirreled away back in August. But the cold weather is yet to come and I hope you'll help me refill the larder before the next issue rolls around.

To begin with these alumni fund notes, I have one from another of our "travellers." **Irving Kusinitz** writes, "I am working on a new plant in Cagna, Venezuela and have spent several days there in December '70 and April '71. Had a delightful skiing trip in January at Davos, Switzerland. My wife and I are awaiting the arrival of our first grandchild from younger son, Ralph." . . . From **William Coleman:** "Still working in research for U.S. Steel. Son David is a junior in college. Wife Louise says hello to all our M.I.T. alumni friends." . . . **Jack Platt** is enjoying warm weather and says "I am still with Frank Moore Realty, Inc. of Hollywood, Fla., as manager and sales associate. We moved into our new condominium apartment last March. It is a spacious, attractive two-bedroom, two-bath southeast apartment overlooking the Bay in North Miami Beach with three balconies and we are enjoying it very much." When a real estate man goes on like that, it almost sounds like a sales pitch, but since Jack didn't mention any price, we'll consider it justified enthusiasm over a new home.

William R. Main writes, "Retired from Penn Central as Assistant Vice President in Spring 1971. Busy but available for transportation and management consulting." . . . And finally **George M. Woodman, Jr.,** says "I am still hitting them off as a supervisory naval architect in the design division of the Portsmouth Naval Shipyard. Recently I checked and found (to my horror) that out of about 700 engineers and technicians there are just three older than I am! Guess that time is fast approaching. My 40th reunion at Bowdoin comes off this year too! . . . Still in the alumni fund area, **George Westfeld** has received a Certificate of Appreciation for his work as regional chairman in the Waterbury, Conn., area. . . . **Frank Milliken** and **Harold Thayer** were among those registered for the inauguration of Dr. Wiesner as new president of the Institute.

It is not often that you find our age still working on formal degree programs, but at least one member of our class has been hard at it. Among those receiving graduate degrees from Harvard last July was **Robert F. Metcalf.** He was awarded a Master of Science. Congratulations for working like this at a time in life when so often we have filled our life with other activities.

On a personal note, we made a sweep through Vermont, New Hampshire, and Maine to see foliage and visit friends and relatives. Our last stop was in Kittery, Maine, where we spent two nights with Winnie and **Ted Taylor.** We had a very pleasant time but it was sad to see what the Colossus of Roads had done to the twenty years of work they had done on their land. They've lost seven and a half of their nine acres to a six-lane highway that will be about 75 feet from the house. Since there are already two bridges across the Piscataqua River at this point, the third one seems somewhat redundant. Especially since the jam-ups on the turnpike bridge were apparently caused mostly by toll collections that will be stopped when the new bridge is opened!—**R. M. Franklin,** Secretary, Satucket Rd., Brewster, Mass. 02631; **G. G. Bull,** Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

35

The following notes were received via the Alumni Fund office: **Bill Seary** writes from Radnor, Pa.: "Following withdrawal of the Budd Co. (Philadelphia) from the Railway Supply Field, I chose early retirement and took eight months sabbatical to relax a bit and recover my savoir

faire. In July I joined up with the Boeing Co., Vertol Division, in their newly-organized surface transportation systems department. My first assignment is manager of quality assurance—Urban Rapid Rail Vehicle and Systems." . . . **Art Haskins** writes from Bath, Maine: "Still in the same rut as manager of new construction estimating, Bath Iron Works Corp. Sail when I can in my Bristol 27 Auxiliary. Cruised to Mt. Desert and Schoodic Peninsula this summer. Race a bit, but no hardware this year. The competition is getting better, just like the college kids are getting younger." . . . **George Reece** writes from Chestnut Hill, Mass.: "Made a member of the Certification Board for certification of operators of Waste Water Treatment Facilities in Massachusetts. Sworn in by Governor Sargent. Was made a director of Fay, Spofford and Thorndike in Boston over a year ago." . . . Speaking of being sworn in by Governor Sargent, **John F. Taplin's** picture was in the paper recently showing him being sworn in as a trustee for the Lowell Technological Institute. John lives not too far from me in West Newton.

Bissell Alderman sent me the following announcement from the firm he helped to start in West Springfield, Mass. in 1950: "The Alderman and MacNeish firm of architects and engineers of West Springfield announces the admittance of new partners. The partnership expands to include its registered architects, John J. Tiboni of Springfield, M.I.T. '54, Philip B. Fregeau and Mark L. Sirulnik of Longmeadow and Douglas E. Strong of West Springfield, M.I.T. '50. Bissell Alderman of South Hadley becomes managing-partner and John J. Tiboni is named secretary of the partnership. The firm will continue its professional practice specializing in the designing of schools, banks, hospitals, housing and industrial buildings."

While golfing with **Bill Bates** he disclosed the fact that he had been with steel companies in Pittsburgh since 1942. Currently he is administrator of sales for U.S. Steel with a 30-man office. His oldest daughter Isabelle graduated from Bucknell, is married, has three children and lives in Burlingame, Calif. Daughter Elizabeth graduated from Wellesley, is married and expecting her first in December and lives in metropolitan New York. Son Joseph is looking forward to becoming a college professor.

Walter H. Stockmayer, Professor of Chemistry at Dartmouth College was the recipient of a National Science Foundation research grant of $66,000. . . . The 11th Annual Class Golf Tournament is down to the finals. **Ham Dow** eliminated **Leo Beckwith** in a match played "nationwide" by mail. **Sam Brown** took me to the cleaners in a "match" at Canoe Brook by 6 and 4. Sam had his lowest round in two years and I couldn't come close. In October Sam and Helen took a four-week trip to Barcelona, Valencia, Rome, Capri, Venice, the Dolamites, Chamonix-Mont Blanc, Normandy and finally Paris.

Certificates of Appreciation are being awarded this fall to 104 alumni for outstanding efforts on behalf of the 1971 Alumni Fund. The 1935 recipients are **Leo Beckwith** our Class Agent and **Joseph Kemper,** Leadership Gifts Chairman for Cincinnati. I hope Joe will take a few moments to write and tell us all about himself.

I am sorry to report the deaths of two of our classmates: **Alden Tower** on September 12, 1970 and **Palmer Koenig** on August 3, 1971. On behalf of their classmates, I am sending belated condolences to Marcia Tower and her two grown-up children and to Dorothy Koenig, her two daughters and three grandchildren—our sincere sympathy.

Here are some late address changes: Dexter Stevens has moved from Summit, N.J. to Parsons Dr., RD#2, Wells, Maine 04090; Leonard Wiener is now at 311 Presque Isle Blvd., Erie, Pa. 16505; Tom Hafer's new address is 2 Avenue der Scheid, Sterrebeed, Belgium; Dick Parli is at 4671 No. Dittmar Rd., Arlington, Va. 22201; Bill Root, Jr. lives at 174 Hawthorne Lane, Concord, Mass. 01742; Herbert Solibakke is now located at P.O. Box 535, Lake Worth, Fla. 33460; Fred Wissenbach is now at 21 Autumn Circle, Canton, Mass. 02021. . . . Once again I would like to ask that you include me on your holiday list if you send out one of those family activity review letters. And a Happy Hanukkah, or Christmas and New Years to you and yours.—**Allan Q. Mowatt,** Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

36

At the class meeting held on June 6 the following officers, etc. were elected: President, **Anton Hittl;** Vice President, **Henry McGrath;** Secretary, **Alice Kimball;** Treasurer, **Eli Grossman;** 40th Reunion Gift Chairman, **Edward Dashefsky:** Alumni Fund Class Agents, **Elliott Robinson** (east) and **Henry Lippitt** (west). By now you have heard from President Tony on the subject of our 40-year gift. Present were: all of the above (except Hank Lippitt), Ariel Thomas, Loreto Lombardi, Bill Fingerle, Fletch Thornton, Bill Mullin, Leo Kramer, John Chapper, Al Dasburg, Jim Patterson, Lou Smith, Larry Kanters, Mike Tremaglio, Walt MacAdam, George Grant, Dick Denton, Py Williams, Larry Peterson, John Easton, John Viola, August Mackro, Mac Nyhen, Hal Miller, Ollie Angevine, Vince Estabrook, Dorian Shainin, Roman Ortynsky, Frank Phillips, John Bete, Tom Terry, Charlie Betts, Dick Koegler, Bill Wu, and Fred Assmann. Gerry Chapman joined us for dinner one evening. Alumni Day in Cambridge brought out in addition to many of those listed above Joe Burns, Herb Borden, Phil Bourne, Bob Caldwell, Ben Cooperstein, Milton Dobrin, Ruth Perkins, Glenn Soash, Louis Stahl, Martin Gilman, Jim Leary, Tom Waram and Bob Caldwell. In all some 53 members of the class are accounted for during that period.

At the Inauguration ceremonies on October 7, **Leo Kramer** and **Louis Stahl** were listed as registrants although I did not see them. I saw **Elliott Robinson** who reports that his son Clayton is now a captain with the Signal Corps in Vietnam at Cam Ranh Bay . . . **Ariel Thomas** was presenting a paper before the Water Pollution Control Federation's 44th Annual Conference in San Francisco on the same day. . . . **Bernard Vonnegut,** as principal scientist, was part of a team which produced an educational film on atmospheric electricity. It was sponsored by the American Meteorological Society.

In the mail bag: a card from **Milton Dobrin** who was on his way to Russia when he stopped off in Cambridge; notes from **Robert Newman,** just back from a month's holiday in Iran; word from **Edson Snow** who will be living at Pompano Beach, Fla., for six months of the year; and a note from **Boynton Beckwith** who has completed 35 years with United Airlines. A travel conflict kept him from attending the reunion.

Norton Miner is practicing general architecture in northwestern Connecticut and thereabouts. He was appointed chairman of the northwestern Connecticut region of the Governor's Task Force on Housing. He reports that he is still pushing modular approach to construction and praying for metrication! . . . **Bernard Gordon** has returned to the San Francisco Bay area after ten years with the state of California on State Water Project Design and Construction. He is consulting in soil mechanics, foundation engineering, and earth dams.

I am very sad to have to report the death on June 13, 1971 of **Frank Berman.** —**Alice H. Kimball,** Secretary, 100 Memorial Dr., Apt. 8-6C, Cambridge, Mass. 02142 or P.O. Box 31, West Hartland, Conn. 06091

37

Our class was represented at the Inauguration of President Jerome B. Wiesner by **Phil Peters** and **Jim Ewell.** . . . **Charlie Reed** has been elected senior vice president, technical resources, of General Electric Co. . . . **Charlie Witsil** has been recuperating from a lung operation, and writes he is still going strong. . . . **Martin Kuban** has severed his connection with Ampco Metals, Inc. as chief manufacturing engineer and has taken a position as project engineer with Logemann Bros. Co. in Milwaukee, a company engaged in building large reprocessing systems and equipment for scrap metals. His daughter, Carolyn, graduated last June from Eastman School of Music having majored in harp.

Sid Mank has retired from his own construction company and is now vice president of Haft-Gaines Co. of Ft. Lauderdale, Fla., which is an affiliate of Fuqua Industries. He eventually planned to retire in Virginia. **Eugene Cooper** has a new title, Consultant to Technical Director, Naval Undersea Center, San Diego. He and his family recently moved to 8597 Prestwick Drive, LaJolla, Calif., 92037. **Les Klashman** after 32 years with the U.S. Government is planning to retire this December. He plans to work as a consultant on environmental engineering problems.

Mark down the date of our 35th reunion at Chatham Bars Inn, in Chatham, Mass., starting June 2, through June 5, 1972. Hope to see you there.—**Robert H. Thorson,** Secretary, 506 Riverside Ave.,

Medford, Mass. 02155; **Curtiss Powell,** Assistant Secretary, Rm-5-325 M.I.T., Cambridge, Mass. 02142; **Jerome Salny,** Assistant Secretary, Egbert Hill, Morristown, N.J.

38

There is plenty of '38 news to report to you this month because a number of you have been good enough to keep me informed. For those of you who have not been sending in news, every bit is appreciated and will serve to make the class notes more interesting to everyone concerned.

If you noticed the Alumni Fund Report, you will see that the Class of 1938 for the first time in its history gave the largest total of gifts to the Fund as well as the largest per capita gifts. As a result, certificate awards were made to: **Frank Kemp,** as Class Agent; **Norm Leventhal,** as a Leadership Chairman; and **John McCrery,** as a Regional Chairman.

An item mailed to us features a picture of **Lloyd Bergeson** and the *Boston Herald*'s comment that he was the keynote speaker at a statewide "Jobs for Veterans" program. Lloyd is vice president of General Dynamics and general manager of Quincy Shipyard. . . . **Chauncey Bell** relates that he will be in Rand's Washington office until late 1972 before returning to Santa Monica. In addition to working closely with air staff personnel at the Pentagon, he is doing some sightseeing in the capitol with his wife; they are enjoying a reunion with his son and family, who have moved to Washington. . . . **Tom Griffin** heads up his own firm, Thomas Griffin Associates, Co., Civil and Sanitary Engineers and Public Works Consultants, "specializing in innovative solutions to exotic (and usually annoying) problems."

Paul Black informs us that he is still responsible for business planning at Electronic Systems Group of G.T.E. Sylvania and remarks that in spite of cutbacks there is an optimistic outlook for their defense and diversification efforts. . . . **Bill Whitmore**'s card tells of his assuming chairmanship of N.R.A.C. Laboratory Advisory Board for Ordnance for the fourth year; he has also been invited to serve as alumni member of the Visiting Committee for M.I.T.'s math department for the next two years. . . . **Al Kilgour,** a registered professional engineer, writes that he is manager of market development, utility sales division of Allis Chalmers Corp., and is also active in various scout programs and church activities.

. . . **Russ Coile** corresponds from Naples, Italy where, he tells us, he and his wife will remain for two years while he is engaged in operations research for the Commander, anti-submarine force, Sixth Fleet.

These notes are being written in October, at a time when I really do not have the Christmas spirit. It *is* the Christmas issue, so accordingly, a Very Merry Christmas and a Happy New Year to all '38ers.—**A. L. Bruneau, Jr.,** Secretary, Hurdman and Cranstoun, Penney Co., 140 Broadway, New York, N.Y. 10005

40

It is with regret that I must report the death of **Bradley L. Newcomb** on August 2, 1971. At the time of his death he was an associate professor of chemical engineering at the University of Connecticut. Bradley was a Course II graduate and received his M.S. degree in 1950 from the University of Michigan. From 1946 until 1954 he was on the faculty of Jackson, Mich., Junior College, and from 1954 until the time of his death was on the faculty of the University of Connecticut. Bradley served as a captain in the U.S. Army in World War II from 1942 until 1946 and then was in the Reserves until 1964 when he retired as a lieutenant colonel. Bradley is survived by his wife Phyllis Lacoy Newcomb, his son Bradley, Jr., and his two daughters, Mrs. Joshua Hufnagel and Miss Janet L. Newcomb. Classmates who would like to give a memorial contribution should send them to the M.I.T. Alumni Association.

It is also with regret that I must report the deaths of two other classmates. **Joe McGinniss** passed away on September 8, 1971. Joe was in Course IV and lived at 3 Green Acres Lane, Rye, N.Y. **Leonard E. Pawlowski** of Course IX died on July 27, 1971. He had resided at 126 Park Street, Nanticoke, Pa. I have no further details at the present time.

Norm Kridel who is now with the Rochester Gas and Electric Co. in Rochester, N.Y., has received the distinguished service award of the Illuminating Engineering Society. . . . *Business Week* for September 18, 1971 reports on president of Alcoa **W. H. Krome George**'s plea at meetings he had with industry leaders in London and Japan to cut back the production of aluminum due to overcapacity. . . . **Bill Morrison** writes, "president, Medical Plastics Corp. of Greensboro, N.C., marketing antibacterial plastics. Married in 1967 to Janis Marshall. Son, Phillip, now 3 years old, is keeping me young. Prior son Lee is a sophomore at Duke and daughter, Jorie, a junior in high school." . . . From **John Quady** comes the note: "After 17½ years with General Dynamics/Pomona Division, I joined the Rohr Corp., Chula Vista, Calif., on May 11, 1970 as manager, advanced systems engineering aerospace systems group. Since joining Rohr, my work has been devoted mostly to R and D in advanced marine vehicles including surface effect vehicles and new concepts in marine propulsion. . . . Merry Christmas to one and all. You make this column. In your 1972 New Year resolutions, act on the one to write to Al.—**Alvin Guttag,** Secretary, Cushman, Darby and Cushman, 1801 K Street, N.W., Washington, D.C. 20006

41

Your secretary had his usual busy summer on the Island. Among the classmates who dropped in the office, or seen by your Secretary on the street, were Bill Cherry, John Mullen, Ed Martin, Carl Mueller and Ken Roe.

Bob Bailey dropped by my office and left a note saying he had seen the "30th" in the window and spotted my shingle. He is now with I.B.M./F.S.D. in Maryland working for LASA Data Processing. I am writing this on a foggy morning on board the boat from Nantucket to the Cape where we are to attend the Nantucket/Providence football game.

The following persons indicated an interest in attending the Inauguration of our new President, Jerome Wiesner: Everett R. Ackerson, Robert S. Lundberg, Edward Marden, Carl Mueller, Nathanial Rochester, Irving Stein, Teddy Walkowicz, D. Reid Weedon, Jr., and Frank S. Wyle.

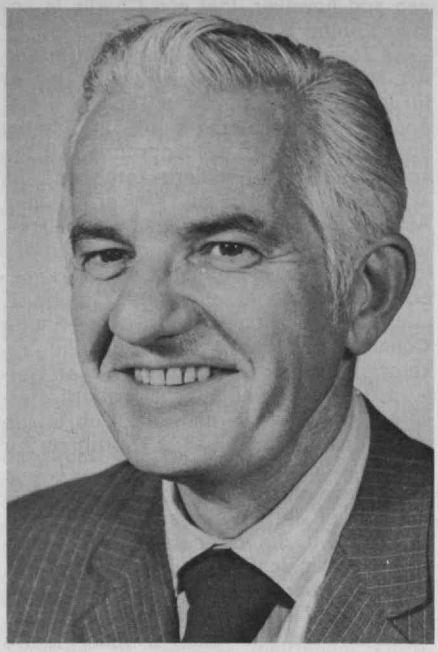
An unprecedented schedule of cases for the October sitting of the Superior Court in Nantucket, kept this converted civil engineer at the bar in not the normal way casually enjoyed all week, and I was consequently unable to attend the Inauguration ceremonies since I was in court until Friday evening that week. It was most frustrating to have planned the trip and not be able to attend the installation of Drs. Wiesner and Gray. Those who attended the 30th reunion will remember the pleasant time we had with Dr. Gray.

The *California Monthly* reports an interesting story on **Albert Bowker** who is now chancellor at Berkeley after serving in the same capacity at C.U.N.Y. "The Bowker Baedeker" presented his impressions as Berkeley's fifth chancellor and proved fascinating reading.

Bell Aerospace Division of Textron announced the appointment of **Stanley M. Smolensky** as executive director of the New Orleans operation on September 29, which announcement was followed on October 6 with the sad news of Stan's fatal heart attack on October 5.

News that **John P. Cutler** has been appointed to the faculty of the School of Architecture and Environmental Design at California State Polytechnic College at San Luis Obispo in California. John moves there from the San Francisco firm of Reid and Tarics. . . . Two members of the Class of '41 received Certificates of Appreciation from M.I.T. in recognition of their outstanding efforts in making the Fund Year a great success. The list shows **Carl M. Mueller** and **Howard O. McMahon** so honored.

The *Wall Street Journal* of August 27 carried a fascinating story on Off-Track Betting, quoting **Howie Samuels** who serves as president of the firm. The story involved a controversy with Computer Sciences Corporation and their association with Off-Track Betting. . . . **Carl Stewart** dropped a line to Walt Kreske during a brief vacation when he said he finally had time to catch up on reading the *Technology Review,* and was particularly interested in the Charles River Associates study for D.O.T. discussed in the June '71 issue on page 70. Carl wrote to thank whomever sent him the Stein from the 30th reunion. He didn't know if it was sent by the Class as a consolation for not being able to attend in person, but wanted to thank the responsible parties. . . . I believe I forgot to mention at the last writing, what an excellent job the 30th reunion committee did in



Stanley M. Smolensky, '41

organizing the most delightful return to M.I.T. All who attended had a ball and the committee is to be congratulated.

Oscar Mapua wrote to me from the Philippines with news of the search for a new president at the Asian Institute of Technology in Bangkok. The college is looking for an outstanding man to fill this post, and Oscar tells me this institution is most important to the countries in the Far East. Unfortunately, the resignation of the president of this institution came at such a time as to make it impossible for Oscar to attend the 30th Reunion, as there was an emergency meeting of the board of directors called in London, and Oscar serves on this board. Anyone who has a candidate in mind should write Oscar at 2661 Taft Ave., Rizal, P.I.

After returning from the 30th reunion, **Luke Hayden** took a forced vacation at the hospital for some repairs, and I have just heard he is back at his desk a few hours a day and recovering satisfactorily. —**Michael Driscoll,** Secretary, Box 1044, Nantucket, Mass. 02554

42

Biggest news this month is our up-coming Thirtieth Reunion so mark off the weekend of June 3 on your calendar NOW! **Harvey Kram** is the Reunion Chairman and his committee has been hard at work since September. You'll be receiving all the details shortly but this one is going to be the big one, the one to remember (till the 50th?). The reunion will be at the beautiful Wychmere Harbor Club on the shore at Harwich Port which is easy to get to either by car or by plane into Hyannis Airport. There'll be plenty of eatin', drinkin', and sportin' including a Saturday nite (no speech) banquet and a Sunday noon clambake, a specialty of the Wychmere Harbor Club.

From Rochester we hear that **Jim Littwitz** has been appointed project director for the Kodak Park Division of the Eastman Kodak Company. In his new post Jim will be directing product development work at Kodak Park with related work in other major divisions of the Eastman organization. . . . **Dick Merritt** has left Davison Chemical in Baton Rouge and is now representing B.I.F. in sales of industrial process, industrial water and waste water and swimming pool equipment in Louisiana and Southern Mississippi. . . . **George Schwartz,** senior vice president of L.F.E. Corp. has been elected chairman of the board and chief executive officer of Anderson-Nichols and Co., Inc., the Boston-based engineering firm recently acquired by L.F.E. . . . Walter Kidde and Co. has consolidated its Crane Hoist group of companies with headquarters at Downey, Calif., under **James E. Stinson** as president. Jim was formerly general manager of Crane Hoist. . . . **Andy Skinner** has joined the Westinghouse Ocean Research and Engineering Center at Annapolis, Md., as senior engineer. . . . And it's no change for **Harold Clemens** who writes that he is still doing business at the same old stand, Clemens' Machine Company in Milton, Pa.

In these days of moon exploration, space travel, and supersonic transports we tend to forget the lowly ferryboat, but **Don Stein** is project engineer for the design of the 6,000-passenger ferry boat for the Staten Island to New York City run. . . . **Fred Sargent, 2nd,** has been appointed to the Executive Committee, Division of Medical Sciences of the National Research Council. He's also serving on the Executive Committee, U.S. National Committee for International Biological Programs and is Chairman of the Educational Panel of the Committee on International Environmental Problems of the National Academy of Sciences. This last one is really a mouthful; maybe we can get Fred on a committee to shorten the titles of international and executive committees! . . . **Bill Wilcox** is receiving a Certificate of Appreciation for outstanding achievement from the 1971 Alumni Fund for his work as Nashville, Tenn. Regional Chairman.

Again, save the weekend of June 3rd, actually the reunion will start on Friday evening, June 2. The cost will be very reasonable, only $25 per day per person including room and food, somewhat less for children. At these prices you can hardly afford to stay home! Complete information and registration cards will be in the mail early in December.—**Ken Rosett,** Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

43

It is with a sad heart that we open these notes. A telegram arrived at Tech in late September which read: "This is to notify you of the untimely death of Mr. **Robert L. Lichten,** Director of Advanced Engineering, Bell Helicopter Co., Fort Worth, Texas on September 18, 1971. Additional information will be furnished later." As of this writing, we are unable to tell you more but all our thoughts went along to Sue Lichten with Dick Feingold's note of condolence. Bob's brief "autobiography" in our 25th Reunion Book certainly gave an account of a happy family group. For those who knew Bob Lichten well, you may wish to drop a note to Sue at 6338 Aberdeen Ave., Dallas, Texas, 75230.

We have a news clipping with a photo reminiscent of frosh chemistry lab, but the test-tube stand, beaker, etc., look too neat and orderly! It's actually **Lewis J. Housman,** who is director of quality control for Stop and Shop, Inc. of Boston. The clip says, "Lou makes sure that there's top quality inside the can or package before we put our Stop and Shop name on the outside." It sounds good all right, but is that your thumb I see resting on the scale, Lou?

The printed program for the National Plastics Conference in Chicago on November 2 indicates that **Walter Netsch** will present a paper titled, "An Architect's View on Plastics in Construction." Not too enlightening by title only, but I suppose he will say that plastics are here to stay! If you ever want to study the all non-plastic variety of building, Walter, please come over to my office in Bayonne, N.J. It was built during the Stone Age! . . . The Joint Engineering Management Conference in Los Angeles in October included a paper "Implications of the Unemployment Crisis" by **John J. Guarrera,** President of Guide Scientific Industries of Sun Valley, Calif. I trust that your material for this subject was not based on personal experiences, John!

The "Back of the Envelope Department" brings several items: **Stanley Paterson** says he is the co-author of a biography of the Boston merchant Thomas H. Perkins which will be published by Harvard University Press October 15 under the title, *Merchant Prince of Boston.* . . . **Henry R. Brown, Jr.,** reports, "I've started my own corporation in the aero-marine navigation and medical-surveillance fields. It is Detection Devices Inc., P.O. Box 1625, Newport Beach, Calif. 92660. My first two products will be a digitally-controlled intrusion alarm and an automotive safety device." . . . **Clinton Kemp** was elected president of Monsanto Biodize Systems Inc., last February; then he proceeded to move the company from Great Neck, L.I., to Chicago this summer. We give up, Clint, what's "Biodize" stand for?

Stanley Proctor reports that his son, John, enrolled this fall in the graduate program at the Sloan School. This puts a third-generation Proctor on the rosters of M.I.T. since Stan's father graduated in 1908. Do we have anyone who would like to equal or top that accomplishment? . . . Your second-string secretary returned from an around-the-world trip in mid-August, having visited various sales reps of Butterworth System Inc., on his first trip as newly-elected president. When the news really gets scarce some month, I'll tell you all about Butterworth. Let's just say in closing that it's my "bread and. . ." and that's the last time I want to hear that corny line!—**A. J. Kelly, Jr.,** 34 Scudder Rd., Westfield, N.J., 07090

45

These notes are being penned at Boston

Logan Airport as your secretary cools his heels having been left behind on an oversold Mohawk flight. Being left behind is one thing but at 7:30 a.m. is another! After 20 years in New York I had thought things like this only happened in the fun city. Despite this inconvenience the Springers are enjoying their new life in New Castle, N.H. Contrary to the beliefs of many, I have not retired. (No such luck!) I continue with M.F.B., now Allendale Insurance, with my time divided between Boston, Providence and air travel. The 800 auto miles per week are well worth the serene beauty of Piscataqua. The latch is always open to our Technology friends.

Others are on the move. After 20 years in Binghamton, N.Y., Lib and **Jerry Patterson** moved to Montrose, Pa., in mid-August. Montrose is truly horse country about 20 miles south of Binghamton: yes you have guessed it; now Jerry commutes to Binghamton while Libby spends her days riding, subject to an assist from Jerry on weekends. Libby advises that their new home is a perfect place for mini-reunions. The Pattersons' second son, Mark, married Donna Huffcut of Vestal, N.Y., on August 6. As described by Libby, the wedding was just beautiful. Neither set of parents contributed time nor money as Donna and Mark planned it all. It had field flowers, guitar music, and love. All were very, very touched by the ceremony. . . . Another marriage to report—Julia Adrian Fogelen to Flint Brayton (**Jim Brayton's** son!) on June 12 in Princeton, N.J.

The **William G. Martins** are now living in Darien, Conn., after six and one-half years in Winnetka, Ill., preceeded by seven years in West Hartford, Conn., preceeded by ten years in the Boston area. Bill's only employer has been Johnson Service Co., manufacturers and installers of automatic temperature and humidity control systems for commercial and industrial buildings. Bill is currently Northeast Regional Manager headquartered in Long Island City. By way of biography Bill reports as follows: "Jeanne and I have been married for 23 years and have produced four offspring. The oldest, Lynne, graduated last June from Mt. Holyoke and is now working for Rockefeller University, New York City. Our second daughter, Beth, is a junior at Wellesley, mother's alma mater, and is currently much involved in the junior shows. My son, Bill, is a senior at Darien High School and participates in football, and basketball. Peter, our youngest, has just entered the seventh grade with a certain degree of anticipation and apprehension." Thanks for a great letter, Bill.

Shell Oil Company has Red Harrington on the move! In mid-August **Matthew B. Harrington, Jr.** was named marketing manager—east in Shell's Central Marketing Region headquartered in Chicago. In his new position, Red is responsible for marketing activities in the Cleveland, Dayton, Detroit, Grand Rapids and Louisville district offices. Red joined Shell in 1947 and has served in several engineering and sales capacities through the years—most recently as retail manager in the Houston headquarters. Red, Jane and all the gang reside at 263 Cherokee

Randall D. Esten, '45 (left) congratulated by Colonel John Oswalt, Jr., on his induction into the "Gallery of Distinguished Civilian Employees."

in Lake Forest, Ill. . . . The **Tom Hewsons** have the right attitude! Now that the kids have scattered to prep school and college, the large New Canaan, Conn., home has been replaced by a condominium at 6 Coachmen's Square in New Canaan plus a 40-plus-foot motor cruiser fully equipped with a captain! The boat has been in Long Island and Vineyard Sounds this past summer and it shall be in Florida and the Islands this winter as Tom reactivates his consulting activities.

Arthur J. Lacroix of the Stratford Division of Raybestos Manhattan, Inc., has recently been named director of R and D at the firm's plant in Breky, Germany. Art has been with the Stratford Division since 1955 and most recently was chief engineer for friction materials. . . . **Robert E. Wilson** continues in the aerospace field with General Electric's Reentry and Environmental Systems Division in Philadelphia. . . . **Robert E. Harris** is now manager, Marine Advisory Programs—Sea Grant Program in Washington, D.C. . . . **Randall D. Esten,** an authority on automation in photogrammetry has been named a member of the "Gallery of Distinguished Civilian Employees" by the U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Va. Randy, an employee of the Labs for 16 years until his departure in 1966 was chosen for the honor on the basis of his following accomplishments: Instrumental in developing the principle of automatic mapping equipment, developing the first P.P.I. Radar Restituter; principal investigator in analytical triangulation and mensuration as applied to mapping and mapping system, etc! Randy, Mildred, and son, David now live in Hendersonville, N.C.

The following classmates attended Alumni Homecoming last June. Frieda Omansky Cohen, Charlie and Nancy Hart, Bill and Mrs. Halton, Don and Margaret Lowell, Tom and Louise McNamara, Art Miller, Warren Miller, John Morrison, Clint Springer, Dave and Marcy Trageser. Dave Trageser told about his Lawrence, Mass., operation which is a Japanese—high-voltage venture; I must confess that I was more interested in the fact that he had made arrangements to keep his sailboat in Newburyport for the summer. I can add however, that son Charlie is enjoying Amherst College.

The **Tom McNamaras, Charlie Harts** and **Art Miller** deserve some sort of award for it was their waitress at Table N-6 that popped a champagne bottle at a most appropriate time; i.e. inappropriate if the scowl on Arthur Fielder's forehead was at all indicative. Paul Keyser, Alumni Association President, has, we believe, properly awarded this famous waitress in accord with his promise at the Homecoming Luncheon, on Monday, June 7. . . . One last Homecoming item—**Freida Cohen** told of her older two sons' reversals! Steve M.I.T. '70 is now at Harvard Business School while Richard, Harvard '71 is now partially at Tech in the new Harvard Medical—M.I.T. program for medical research.

You have all read, I know, with great emotion of Jerry Wiesner's inauguration as President. Suffice to say that Corporation member **Jeptha Wade,** Paddy Wade, Julia and **Sherry Ing** plus yours truly shall always cherish those emotional moments as attendees. Oh yes, a most Merry Christmas and Happy New Year to you and your families.—**Clinton H. Springer,** P.O. Box 288, New Castle, N.H. 03854

46

We will be nearing Christmas when you read these class notes and so we would like to wish you all the best of holiday greetings and a very happy and healthy new year. The mail has been quite sporadic but of excellent content the past months. We would appreciate it very much if those who did not attend the reunion would write us on your activities these past years.

Richard Dreselly has written a fine card from his home in Gardiner, Maine. Dick is with the Maine Highway Commission as an engineer-programmer and enjoys his work very much. He is married to a charming lady, a nurse, and they have one son. In 1957 Dick crossed the Atlantic alone in his 30-foot sloop, and in 1970 he piloted his family to California in a small plane. Dick spent 1966-67 in Vietnam and this experience has increased his opinion we should not remain there any longer. . . . **Rick Adler** has written from New Orleans that he is vice president—engineering of Equitable Equipment Co., Inc. Their principal business is shipbuilding, and his company has a new contract with Lykes Bros. Steamship for 245 Seabee barges. Lykes Bros. vice president of engineering is Stuart Thayer who spent most of his Tech years with the class of '46. Rick and his wife have three children, two girls 14 and 12, and a boy 8. . . . **Edward T. Clapp** is completing 30 years of government service, presently with the Weather Bureau Forecast Office in Suitland, Md. Ed's wife, Jane, is also employed in the same building. They are looking forward to their son, Marc's, graduation from Antioch College in June.

D. L. Crinklaw retired from the navy in November, 1970. He is now with Litton Ship Systems as a senior marine engineer. The family is building a new home in Malibu, Calif., which should be com-

pleted now. . . . **Betty Bunte Stevens** has sent a short note on her projects the past years. Her older daughter is in her second year at the University of California at Berkley, a son is a freshman at Northwestern and a second daughter has completed the third grade. . . . **John Weingarten** reports he is now manager of purchasing, Thiokel Chemical Corp., Chemical Division, in Trenton, N.J. . . . **John M. Dudley** has completed a sabbatical year at the Oak Ridge National Laboratory, Thermonuclear Division. . . . **Roy L. Klein** is now manager of projects for Fluor Corp.

John P. McLarty, consulting engineer, resides in Birmingham, Ala., and has been serving as president of the Birmingham Chapter of A.S.H.R.A.E. . . . **Angus MacDonald** has written a fine book on his life, *Middle Ground,* which I am sure every one in the class would enjoy reading for so many of his experiences are like ours and our generation. . . . **Kenneth N. Davis** has been named executive vice president, Systems and Services, of General Instrument Corp. Ken, his wife, Corinne, and three daughters reside in Pound Ridge, N.Y.

William Francis Brace, Professor of Geology at M.I.T. has been elected to the National Academy of Sciences in recognition of his distinguished and continuing achievement in original research. . . . **James S. Craig** has received a Certificate of Appreciation from the Alumni Association for his efforts on behalf of M.I.T. as reunion gift chairman. . . . **David J. Tobin** and **Angus MacDonald** attended the inauguration of President Jerome B. Wiesner in Cambridge.

We are saddened to report the deaths of two classmates, **Frank B. Wilder,** who died January 27, 1971, and **Arthur W. Erion,** who passed away on July 16, 1971. We have no further information on these untimely events. . . . Until next month.—**Russ Dostal,** Secretary, 18837 Palm Circle, Cleveland, Ohio 44126

47

The year really flies and I note that this is the December issue so our best for a pleasant holiday season. Before getting into the mail I want to report that I talked to Alex Halberstadt '46, who advises that **Gabe Cicconne** was married within the year. I have no further details. Was this our last bachelor? . . . **Carl Eyman** drops a note to say that one suggestion for increasing the size and number of gifts from the Class is to increase the motivation of the potential giver. His thoughts: Endowment of the Coop barbershop perhaps or designation of the R.O.T.C. program as recipient. **Dick Mooney** are you listening? Better still, Carl, let's you and I play the 19th hole again next June. That's what started me on this job.

Dan Carmody is now manager of purchase of equipment, construction and engineering services for Union Carbide at headquarters in New York. Helen and he with their nine children live in Mt. Vernon. That nine could be a winner. . . . **John Maxfield** has recently been reappointed Chairman of the Math Department at

K. N. Davis, '46

W. B. Reals, '47

D. Kornreich, '47

Kansas State. He and wife Margaret (Oberlin '47) have had published a text titled *Abstract Algebra and Solution by Radicals.* . . . **Dave Lull** is now working for the Naval Weapons Laboratory at Dahlgren, Va., and recently attended a four-week course in urban studies at the Institute. . . . **Lewald Loebel** writes that he is now with a high quality German firm after retiring from U.S. Government Service while in Frankfurt, Germany. His retirement from Government service was due to typical bureaucratic snafus which appear to be part of our times.

Harvey Miller writes with legibility that can be compared only to my own. He has a married daughter and a son starting his junior year in M.E. at Northeastern. Professionally he is active in engineering societies of greater Boston such as P.E. Corrison Engineers, Welding Society and is president of Nelifco Alloy and equipment. . . . **Harl Aldrich**'s firm Haley and Aldrich was given an honorable mention by the Consulting Engineer Council for its work on a support system in the excavation of One Beacon Street. . . . **Ken Marshall** has been named president of the Health Industries . . . **Willis Reals** is now general manager—supply and distribution for Texaco remaining in New York.

Don Kornreich has set up Kornreich Products Inc., to develop and manufacture metal honeycomb core and sandwich panels for construction, aerospace. The firm will be located in San Marcos, Calif. . . . Awarded for their work on the alumni fund were **Jack Rizika,** our class agent; **Cliff Corbett** for Swarthmore and Ambler, Pa.; **Alexander Ward** for Shaker Heights, Ohio, and **Reynold Grammer** for Rochester, N.Y. Very good work men. Please do drop me a note even if illegible—**Dick O'Donnell,** Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

48

Jack Page has launched this year's Reunion Gift Activities with a rally in New York City that was written up in the Alumni Fund records. While Jack, Ken Brock, and Sonny Monosson demonstrated the program to raise a megabuck from the great Class of '48, the onlookers battened down their checkbooks and tried to talk about the location of our 25th Reunion.

Classmates at the rally included Bob Wofsey, Dick Baxter, Bill Bangser, Em Callahan, Stan Fingerhood, John Kirkpatrick, John Reid, and Jack Walch. Our New York classmates reached a clear consensus that the campus is the best location for our 25th Reunion. Interesting, because a few weeks earlier a Boston meeting had the exact opposite view. Apparently the "locals" want to get away and the others want to come back. Sonny would appreciate all views, so if you have an opinion write him at Boston Computer Group, 15 School St., Boston, Mass. 02108.

Thence to the main business—our 25th gift and the megabuck. Jack Page is sending a letter to the entire class, which you may have received by now, outlining the plan and asking for a response—not money but interest! Please return the postcards and flood his mailbox.

The strategy is this: we now have $140,543 towards a $1,000,000 total in June '73. We must, inevitably, look for about 80 per cent of the balance to come from 20 per cent of the class. Thus, we need one gift of $100,000; two of $50,000; four of $25,000 and eight of $12,500—over the five-year period ending with reunion. To do this will require a large class organization and many personal calls on those who are capable of making the larger gifts. During the meeting we reviewed the names of all classmates in New York, New Jersey, Pennsylvania and Southern Connecticut to identify potential workers and givers. **Bob Wofsey** has agreed to coordinate this area and would appreciate hearing from any who are willing to help. Reach Bob at Arthur Young and Co., 277 Park Avenue, New York, N.Y. 10017, telephone number 212-922-2000.

William H. Boysen has been appointed manager of cost accounting and budgets at Fafnir Bearing Co., a division of Textron. . . . **Robert L. Stern** has been elected a Fellow of the American Institute of Chemists. . . . **Mark E. Kirchner** recently spoke before the Fairfield, Conn., Rotary Club on the controversial S.S.T. aircraft. Mark joined Boeing in 1949, and was made chief of the aerodynamics staff in the Commercial Airplane division in 1960. He has worked extensively in the development of the 727 and S.S.T., and the 707 and 720 transport series. . . . New family addition: Julie Christine on June 8 to Mr. and Mrs. **Richard W. Baker.** . . . Moving time for some of our classmates: **David W. Dyer** has been transferred to South Africa as a director of finance with Union Carbide. . . . **R. E. Chandler,** Vice President of Research and Development with the Diversey Corp., having returned from seven years in the United Kingdom, is now in Chicago, but shortly will be moving again to London. . . . **Ralph H. Vacca**

Captain Bill Porter, '48

is at the moment with the Mitre Corp. in Brussels, Belgium, but expects to be back in this country by the end of this year.

Philip A. Dick, after 20 years service with Massachusetts Department of Mental Health, is now employed by McKee-Berger-Mansueto, Inc., and is working on the first phase of construction for the new University of Massachusetts. . . . **Jim Rattray** has been named president of International Beef Breeders, as well as Hoffman-Taff. It figures if you consider a bull as a chemical reactor converting alfalfa to genetic material. . . . **Sara B. Michal** taught chemistry for two years, now has a son at Colgate. . . . **Norman H. Kreisman** is taking the year off to work full-time in the presidential campaign of Senator Henry M. Jackson. . . . Captain **Bill Porter,** Commanding Officer of M.I.T. N.R.O.T.C., took part in the Annual Turn-around Cruise of the U.S.S. *Constitution* in Boston Harbor on June 23.

This fall, M.I.T. is awarding Certificates of Appreciation to alumni who have made outstanding efforts on behalf of the Alumni Fund. The members of the Class of 1948 receiving these awards are: **George H. Wayne, Jack C. Page** (two awards), **Stuart W. Thayer, Denman K. McNear, James E. Armington,** and **James C. Nagel.**

Thomas H. Pigford has been made a Fellow of the American Nuclear Society. He also was named winner of their Arthur Holly Compton Award for 1971 in recognition of his excellent contributions in the field of nuclear engineering education. Dr. Pigford is presently Professor of Nuclear Engineering, Department of Nuclear Engineering, University of California.

The September 12 *New York Times* had an article of interest to all of us on the inefficiency and cost in state government. This article concerns the work being done by the management consulting firm of **Warren King** and Associates. Warren's firm works in this fashion. The governor of a particular state appoints a leading businessman to set up a nonprofit organization to study ways of cutting costs in the government. The business forms a committee of top men to make the study, and goes to the rest of the business community for financial support. Warren's firm then guides the committee through an intensive 12-week study of all phases of government, and at the end of this time a detailed report is made. Several states have made or are in the process of making such studies; many states are already realizing substantial savings after implementation of the study's recommendations. Tennessee expects 78 per cent of its study can be implemented, and also expects the net annual savings from 7-1-72 to 6-30-73 to be $75,809,000. In Indiana this spring's recommendations already add up to a potential annual saving of $26.7 million. Other states at present undergoing studies under Warren's management consulting force are Pennsylvania, South Carolina, and Connecticut.—**S. Martin Billett,** Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

49

Autumn colors are at their peak as I put together this column, starting as usual with notes from the Alumni Fund envelopes. The brilliant colors outside divert attention from other aspects of the environment which are now the province of our first contributor. **Bruce Campbell** writes, "resigned as principal in Bruce Campbell and Associates and on August 16, 1971 was sworn in by Governor Francis Sargent as Massachusetts Commissioner of Public Works." Good luck, Bruce. You'll probably need it. . . . **James E. Ryder** reports that he, "has formed the firm of Ryder, McAulay and Hefter in New York City, which is engaged in the practice of patent and trademark law." . . . **Kenneth M. Prytherch** has been elected vice president of the American Dye Manufacturers Institute (A.D.M.I.), an industry association of the United States producers of dye stuffs. When last heard from, Ken was with General Aniline and Film Corp., in New York City.

John D. Alden has been building an expertise in the general area of engineering employment since 1965. Two presentations illustrated this: one on October 5, 1971 in San Francisco for the 39th Annual Meeting of the Engineers Council for Professional Development on "Job Opportunities for 1971 Graduates—Baccalaureate and Advanced Degrees"; the other scheduled for February 16, 1972 in New York City for the American Association of Cost Engineers on "Trends in Engineering Employment, Present and Future." John directs the manpower programs of Engineers Joint Council in New York City. These programs include E.J.C.'s biannual salary surveys, annual surveys on engineering enrollments and degrees, periodic studies of engineering manpower supply and demand, and special surveys on related topics. He also serves as executive secretary to the Engineering Manpower Commission.

The Eleventh Annual Measurement Systems Engineering Short Course will take place in Arizona State University January 24-28, 1972, and as usual very much involved will be **Peter K. Stein,** Professor of Engineering, who will be responsible for 14 lecture sessions out of the total of 30 in the five-day course. The program emphasizes measurements for design, for which the critical question is stated to be "what would the measuring system read if it were not there?"

Peter Lehner, Treasurer of Leigh Textile Co., of Boston, was graduated in July from the Advanced Management Program (A.M.P.) of the Harvard University Graduate School of Business Administration. Peter was one of 154 senior executives who were members of Harvard's 61st A.M.P. class and he joined the now 7,120 A.M.P. Alumni. . . . **Alex d'Arbeloff** has become president and chief executive of Teradyne, Inc., replacing Nick DeWolf, '48, who was named the company's first chairman. The change means that Alex will assume more of the executive functions, while Nick will be free to devote more time to the technical side of the business, particularly the exploration of potential areas of new product development. Teradyne was founded by Messrs. d'Arbeloff and DeWolf in 1960. Congratulations Alex and good luck.

The January *Technology Review* is a month away for readers, but because of staggered editorial deadlines is only a week or so away for me. See you all shortly. Best wishes to all.—**Frank T. Hulswit,** Class Secretary, 77 Temple Rd., Concord, Mass., 01742

50

Myles S. Spector reports that he is busy in a volunteer job as commissioner and treasurer of the Hackensack Meadowlands Development Commission, trying to solve the many problems of this regional development authority—including the disposal of 40,000 tons of solid waste each week—all this in addition to earning a living! . . . **John Kern** tells us that he drove his family out for Alumni Day last June and they all thoroughly enjoyed the hospitality of the natives and conviviality of the visitors. He recommends it as an annual trek. . . . **David B. McLeod** informs us that, as of June 1, 1971 he is the vice president manufacturing at the Appleton Wire Works Division of Albany International Corp.

Among the three professors at M.I.T. who have been elected to membership in the new Institute of Medicine of the National Academy of Sciences is Dr. **Robert W. Mann,** Germeshausen Professor of Mechanical Engineering. Dr. Mann lives in Lexington, Mass. The total membership of the Institute now stands at 108. . . . **Jack Weaver,** Treasurer of Class of 1950, has been elected vice president of Park Construction in Boston, Mass., a company involved in the field of constructing schools and public buildings in the New England area.

We regret to announce the death of **Morris L. Waters.** Mr. Waters died in August, after a long illness. He was employed by Infomatics, Inc., of Los Ange-

les. Besides his widow and father, he is survived by a son, Harris Waters of Northridge; two daughters, Carol of Florida, June of Northridge.

After four years as director of planning and economic evaluation, in Olin Corporation's Chemicals Group, **W. Leslie Allison** has shifted as of September 1, 1971 to product management. He is currently general product manager, Urethanes. As such, he is concerned with short and long-term fortunes of Olin's polyols, isocyanates and urethane systems. Mr. Allison has resided in New Canaan, Conn., since 1966. He has two daughters in high school and two sons in grade school. . . . Certificates of Appreciation are being awarded this fall to 104 alumni whose efforts on behalf of M.I.T. in the 1971 Alumni Fund were outstanding. Among these are **Morton I. Goldman, William D. Walther** and **Andrew C. Price, 3rd. . . . William Murphy,** Director of Buildings and Grounds for Harvard University, was graduated in July from the Advanced Management Program of the Harvard University Graduate School of Business Administration in a ceremony at Burden Hall. Harvard's 61st A.M.P. class was composed of 154 senior executives, including high-ranking businessmen, military officers, and government officials from the United States, Canada and 21 countries overseas.

B. F. Goodrich General Products Co., of Akron, Ohio, has named **William B. McGorum, Jr.,** to divisional manager of customer service, distribution and operations. Mr. McGorum joined B.F. Goodrich in 1961 as staff supervisor in the corporate market planning department. He was named manager of marketing research in 1963, manager of planning in the corporate planning department in 1964, and administrative assistant to the president of B.F. Goodrich Consumer Products Marketing Division in 1968. He resides in Silver Lake, Ohio.—**John T. McKenna, Jr.,** 2 Francis Kelley Rd., Bedford, Mass. 01730

51

As an assistant class secretary **John Dowds** of Oklahoma City will write these notes from time to time, but news of his own achievements will practically fill this column without further contributions. He is regional chairman of the M.I.T. Educational Council; regional chairman of the M.I.T. Alumni Fund; Commander of an Air National Guard Unit elected as the outstanding in Oklahoma in 1969; president of an oil exploration company which has recently discovered 20 billion cubic feet of gas and two million barrels of oil in southern Kansas; a speaker at an international symposium in mining science and techniques on his use of the "statistical approach to exploration and development through a computerized system of progressively modified drilling probability"; and author of a paper for the 1971 McGraw-Hill yearbook on science and technology having to do with bayesian analysis, Markov chains, entropy and information theory, etc. For good measure he claims to be active in church and Lions Club. With all that spare time, John, I'll expect a lot of help on these notes.

R. W. Mann, '50

W. B. McGorum, '50

Fred Lehmann, '51 (right) sworn in by Governor Sargent as member of the Governor's Advisory Council on Comprehensive Health Planning.

Another assistant class secretary with spare time is **Sam Rubinovitz** who has recently been named general manager of the Electro-Optics Division of EG and G, Inc., at Salem, Mass., after eight years of service with the firm in various marketing and operating positions. Sam has responsibility for products which produce, detect and measure light, such as xenon flash tubes, light instruments, solid state photo detectors, flash equipment and specialty transformers. Many of these components and instruments are sold directly to leading manufacturers of office copiers, photo typesetting units, and other reprographic equipment. Extra-curricularly, Sam is a director of the Washingtonion Hospital in Boston, a director of Temple Emunah in Lexington, and father of two sons, 13 and 9.

After three years as manager of engineering at a liquid meter and valve plant in Statesboro, Ga., **Bill Shenkle** has moved back to Pittsburgh. Still with Rockwell Mfg. Co., Bill is responsible for developing hardware to move into fire protection and safety equipment markets. . . . **Avrom Handleman** writes from St. Louis that he is working in chemicals and hardware for forest fire fighting. Married to Claiborne Philips (Smith '54), they have two children. Send us the name of your company next time, Avrom. . . . Anyone wanting information on lunar micrometeorites write **Lou Galan** in Ann Arbor. He's program manager of experiments in this area for Bendix Aerospace Systems Division. Lou and his wife Jeannette have two girls, 11 and 7.

Tom Friedrich moved wife, four boys and one daughter to Niles, Mich., about a year ago where he is now vice president of French Paper Co. . . . **B. Warren Foster** is a senior engineer with Raytheon Co., lives in Braintree, has one daughter who attends Keene State College, and operates ham radio station W1WZQ. . . . From Southampton, Pa., comes a note from **Burton Dempster** who is a manufacturer's representative with J. J. Wild, Inc. and the father of three boys. . . . **William O'Connell, Jr.,** with I.B.M.'s World Trade Corp. has moved from Poughkeepsie to Stamford, Conn. . . . Some people have bigger problems than others. **Rodwell** (Rip) **Todd** is with the ad agency handling du Pont's petroleum chemical division, world's largest supplier of lead anti-knocks. . . . **Arthur Krasnow** founded Atomic Personnel 12 years ago. He writes that the upheaval in technical employment throughout the country makes good business for him.

Jim Ballou is now professional affiliate of Stahl-Bennett, Inc., Boston architects, but still retains his practice in Salem, Mass. Jim was project architect for the restoration of the Faneuil Hall market buildings last year. He also reports he is "feeling the pinch" resulting from three of his five daughters being in college. Pinch or strangulation? . . . Here in Iowa, the leaves have fallen and we can see the Raccoon River through the trees again. That's the unpolluted Raccoon River, by the way, for those of you looking for the good life. Regards.—**Fred W. Weitz,** Secretary, 4800 S.W. 74th St., Des Moines, Iowa 50321; **Marshall Alper,** Assistant Secretary, 1130 Coronet Ave., Pasadena, Calif. 91107; **John Dowds,** 1800 N.W. 18th Oklahoma City, Okla. 73106; **Samuel Rubinovitz,** Assistant Secretary, 3 Bowser Rd., Lexington, Mass. 02173

55

The holiday season is upon us again, and for most of us it is a time to contemplate snow tires and childrens' colds. It is also a good time to remember friends and acquaintances of years past, some of whom aren't contemplating snow. I received a note from Edie and **Bob Greene,** who are in Indonesia. Bob has extended his tour there as administrative officer for the Ford Foundation until June 1972. Their three daughters enjoy the Joint Embassy School and their house full of pets (monkeys, cats, dogs, lizards, and assorted bugs). The Greenes came back to the Boston area for a month this summer, and Bob is presumably back at work after an Asian tour on the return trip. Their mail address is P.O. Box 2030, Djakarta, Indonesia.

James H. Eacker is currently employed as director of facilities development for the Tufts-New England Medical Center, and director of facilities and capital planning for the related medical schools. Jim is active in town activities, and besides assisting in the raising of children Suzanne and Douglas, he is chairman of the Zoning Board of Appeals, member of the conservation commission, and president of the historical society. . . . **Paul D. Goldan** is working as a plasma physicist in the N.O.A.A. Aeronomy Laboratory in Boulder, Colo. He and his wife Mary have

three children, David, Becky, and Danny. The family enjoys the change to Colorado after Paul's brief stint on the faculty at Dartmouth College. . . . **Dave Wilbourn** returned to M.I.T. as a Sloan Fellow in the '69-'70 year. After the end of the program he decided to apply his education by investing in a small electronics company in Waltham that was in hot water. Now he is chairman of the board and is working hard to head the company to financial recovery. At last report the signs were good, and we wish him success. . . . **Martin Gilvar** is still designing bigger and better rolling mills for the steel producers of the world. He is chief mechanical engineer of the Morgan Construction Co., and lives in Westboro, Mass., with wife Meg and children John, Jenny, and Ted. He says that he looks forward to any Phi Delt buddies dropping by on their way to the M.I.T. Placement Office. . . . **Robert W. Temple** joined Pemar Engineering as executive vice president last spring. The firm is a food process engineering and construction company headquartered in Coral Gables, and he is interested in hearing from any Yankees that break through the ice crust and make it to Florida's sunny shores.

Attending the 1971 Mexico City M.I.T. Club Fiesta were **Gustavo A. Herrera** and his wife Ana Maria, and **Marcos M. Suarez** and his wife Magdalena. . . . **Henry B. duPont, 3rd,** was recently appointed to the advisory committee of the Fairfield offices of the City Trust of Bridgeport, Conn. . . . The Eastman Kodak Co. announced the appointment of **James H. Duffy** as an engineering associate. He is supervising engineer for the industrial engineering division, and he and his wife Mary are raising their two children in Irondequoit, N.Y.

I was dismayed to find that the alumni office has apparently lost all record of our fondly remembered classmate **Lawrence Begetta.** Larry was an outstanding scholar, and his thesis forms a part of Grand Finster Dam, the largest papier-mache' dam in the northwest. Perhaps the misunderstanding at graduation ceremonies may have played a part in the loss; as you recall, Larry, an ardent soil conservationist, buried his diploma in a corner of Rockwell Cage. This led to some consternation and the resultant expunging of his name from the class records. However, I called Mr. Orgone C. Venial of Buildings and Power, and, sure enough, he still has the dossier and mug shot of Larry obtained during one of those spring surprises. Don't let your memories fade; send me some news to share with your classmates.—**Allan C. Schell,** Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

57

Just after sending off the column for the October issue I received a letter from Don Peterson which enclosed the following clipping from the *Kansas City Star* of August 15: "**Paul Frederic Cotter,** 35, chief engineer for Troug-Nichols, Inc., Lenexa, died yesterday at St. John's Hospital at Springfield, Mo. Mr. Cotter suffered a heart attack Thursday while water skiing in the Damdenton area of the Lake of the Ozarks. He was on vacation. He was born in Emporia, Kan., and lived in the Kansas City area for 25 years. He was graduated in 1953 from Wyandotte High School in Kansas City, Kansas, received a bachelor of science degree in 1957 from the Massachusetts Institute of Technology and was studying for his master's degree at the University of Missouri at Kansas City. He was a registered professional engineer. He attended the Rolling Hills Presbyterian Church, was a member of the Lenexa Chamber of Commerce, a past president of the Dorothy Moody Elementary School P.T.A. and was a member of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, the Alpha Tau Omega social fraternity and the M.I.T. Alumni Association. He was a lieutenant in the Air Force from 1957 to 1959. Mr. Cotter leaves his wife, Mrs. Karen Maxwell Cotter, a son, Todd, and three daughters, Ellen, Susan, and Jan, and his parents, Mr. and Mrs. Charles L. Cotter, and a brother, Charles P. Cotter. The family requests no flowers and suggests memorials to the M.I.T. Scholarship Fund be sent to the home."

Don Peterson's letter read as follows: "Sorry that the first time I write to you is to relay sad news. Our classmate Paul Cotter died recently and I know you'd want to get it into your column. Paul was an A.T.O. and in the Mechanical Engineering Department. Troug-Nichols is in the air-conditioning business. His wife Karen determined soon after his death that memorials to him should be in the form of a scholarship fund in his name at M.I.T. Paul and I were planning to reunion at the cabin of **Samuel C. McIntosh** in Crested Butte, Colo., in early September, (It's almost as hard to get to as Helsinki) just as we have done the past two years. **John Armitage** also joined in last year. John now resides in Boulder, Colo., with his two children; his second love is flying gliders. Sam is a professor at Stamford and teaching science fiction among other things. His first child arrived last year. I'm sticking with my three boys until the others catch up and still trying to make electric motors in Newark. Best regards, Don." I'm sure you all join in wishing Karen and the four children great strength as they face the future. The selection of the M.I.T. Scholarship Fund for memorials for Paul was certainly a fine idea.

Now for some news on reunion plans. **Mal Jones** sent me the following outline: When—June 3 and 4, 1972; Where—Provincetown Inn, Cape Cod; Chairman—Jim Cunningham; Cost—Probably $120-$150 per couple for the two days; Wives—yes; Children—no. Mal then added: "We're negotiating for a boat ride down and back from Boston as an extra feature." . . . The last note of the month is about **Frank Salz.** He's been changing jobs every 5-7 years. Now, as he himself says, he's taken this practice to its extreme, and changed careers. The news clipping he sent me reads: "Opens Law Office. Attorney Frank Salz of Simsbury opened a general law office at 266 Pearl St. A member of the American and Hartford County Bar Association, Salz was graduated from the Massachusetts Institute of Technology with a master's degree in mechanical and nuclear engineering and received his J.D. degree from the University of Connecticut. Before practicing law he was president and co-founder of Computer Systems and Education Corp. Before that he was a research scientist at the United Aircraft Corp. laboratories in East Hartford." . . . Well that's all for 1971. My best wishes for the holiday season. I'd certainly appreciate greeting cards with some news enclosed.—**Frederick L. Morefield,** Secretary, Tiirasaarentie 17, Helsinki 20, Finland

58

During a West Coast jaunt around Labor Day I had a chance to visit with **Dick Eiler** at Electronic Arrays in Mountain View, Calif. As many of you know, Dick is marketing manager there and has been with them about seven years—which must be some kind of record for the industry. Prior to this post Dick was at Fairchild Semiconductor and Wright-Patterson A.F.B. He and Betty and their four children are living in Saratoga, Calif. . . . **Edwin Bell** wrote us that he has "accepted the position of general manager of Richardson Homes Corporation's mobile home manufacturing facility in Plant City, Fla. In July we moved from Pasadena, Calif., to Lakeland. We miss California's mountains and nearby skiing but like being able to breathe again."

Dick Barone is working at Texas Instruments in Attleboro, Mass., as a project manager in the technical center. "Kay and I celebrated our son's second birthday in September and are waiting for another addition in December." (And another happy tax deduction, he hopes.) . . . A rather cryptic note arrived from **Robert Parente:** "No longer prof. at U.C.L.A.—perished rather than published—now an engineer at S.D.C. Santa Monica." . . . **W. Gale Haggard** has been "working for over two years in applied research for the National Weather Service which is now part of the new National Oceanic and Atmospheric Administration. Hope the recent emphasis on the environment continues to increase. We are enjoying our two daughters, age 6 and 3."

Faithful readers of the Sunday *New York Times* have become aware of **Stan Klein**'s stimulating articles on technology and the society. Recent articles have focused on the safety of engineered products used in the household, minority hiring practices, and the role of the scientist in society. . . . **Alan Cooper** is a partner in the architectural firm of Cooper and Warterfield in Nashville, Tenn. Before starting this firm, Alan was with Sert, Jackson Gourley and Associates in Cambridge, and also spent two years with Andreault et Parat in Paris. "I have enjoyed designing and planning large institutional and recreational projects here. I have also been serving as the middle Tennessee admissions officer for M.I.T. In my spare time I have become active in efforts to preserve the historical architecture of Nashville and Davidson Coun-

ties." . . . And speaking of historical architecture, the Boston South End Historical Society house tour this past May attracted many classmates: Joe Walsh, Bebe and Gary Fallick, Helen and Jeff Ingram, Louise and Marty O'Donnell, and Kathy and Glenn Strehle. Unlikely historians, perhaps? Well, there was a cocktail party at my house in the South End as part of the day's festivities. Which reminds me to remind you to be sure to call when you're in Boston on business or pleasure. You're invited over to see the restoration taking place in the old city—and for "refreshment." It's 30 Dartmouth Street and the phone is 267-6686. Best wishes for a happy holiday season and peace in the new year.—**Michael E. Brose,** Secretary, 199 Sudbury Rd., Concord, Mass.; **Antonia D. Schuman,** 22400 Napa St., Canoga Park, Calif.

61

The tenth reunion is just a vague memory now but a pleasant one. People started arriving at MacGreggor on Friday afternoon and pronounced the free accommodations in the four-bedroom suites most satisfactory. A sedate party in the court of McCormick preceded the Saturday dinner and I remember seeing a group of rather elderly alumni and wives looking across the court with what appeared to be nostalgia for their own younger and louder days. About 100 people showed up on our side of the court and voted in the establishment slate of class officers. The major change was that **Ira Jaffe** left the class presidency, since he felt that it should be in the hands of someone living around Cambridge. The presidency then fell into the hand of **Jerry Grossman. Tom Hastings** is in charge of the treasury and I'm still here. **Grady Harris** made an impassioned plea that we all give money to the Institute and was rewarded by being re-elected as class agent.

Around ten that night we went over to Kresge to see the *Proposition* improvise. There was a minor snafu and we had to sit through the last half hour of an L.S.C. movie before the play began. On Sunday the weather was perfect for a spectacular clambake at Castle Hill. The whole Crane estate was ours for the afternoon and after eating, people wandered over the rolling grounds overlooking Ipswich Bay. Everyone brought their children and the scene was quite idyllic. **Pete Bankson** lost a kite deep in some woods and its recovery was the principal athletic activity of the afternoon. I recall that three very hip-looking hippies somehow managed to wander in and how they were treated as honored guests—getting free food (leftover dessert).

The questionnaire we sent out last spring has been quite a success. At the time of the reunion 260 people had sent theirs back and more have come in since then. If you still have yours please fill it out and send it in to me. The results are, someday, going to be studied more carefully but here are some of the raw data. About two-thirds of the respondents said that they would want to go to M.I.T. again if they could "do it all over again." The other one-third mentioned places like Harvard or Stanford as places they would have rather gone to college. The majority would have studied "about the same" but a surprising 20 per cent said they would have liked to have done more extracurricular activities. It was generally agreed that we would encourage our children to go to M.I.T. if they were scientifically inclined but 113 people would discourage a daughter from coming to M.I.T. Recalling the virtues of M.I.T. people cited the heavy academic requirements, its reputation, the excellence of the curriculum and the intellectual stimulation. The heavy emphasis on grades and size of M.I.T. were not thought of with any particular affection. Looking back, the majority felt that M.I.T. was important to them BOTH as academic preparation and as a credential. A cynical 41 felt it was more of a credential than anything else. Most people would have stuck to the same major and most people eventually went on to graduate or professional school. Two thirds of the respondents have received a degree above a bachelor's.

Three of the questions dealt with one's happiness as a freshman, senior and now. There is an obvious gradient in the responses. People were least happy as freshmen (at least that's how they remember 1957) got happier as seniors and they are quite content now. Only one person said he is very unhappy now while 16 remembered being unhappy as freshmen. As one might expect, the majority felt they had received lower grades than they "had hoped for," and that they had to study a lot harder than in high school. On current M.I.T. policy, people felt that M.I.T. was handling student demonstrations "about right" and that M.I.T.'s defense-related research should be reduced either to a moderate level or to zero. Next month I'll finish off the results of the questionnaire and the following month I'll try to relate these results to the results of the Sussman report on our class when we were freshmen.

Autumn has arrived in New England and with it hordes of students. Every year the students look more disheveled to me. Are they really different or am I getting middle-aged? Tune in next month for the answer to this fascinating problem. I will have more data since I'll be teaching some juniors at Brandeis the wonders of genetics while I learn more about the generation gap.

Recently removed from the ranks of the student hordes was **James Kee** who got a doctorate in public health at U.C.L.A. in 1970. Now he is a "Medical Services Specialist" in the San Francisco office of H.E.W. . . . Another doctorate in 1970 went to **Ed Whitman.** His degree was in E.E. at the University of Maryland. He now works at the Naval Ordnance Labs as a group leader in underwater ordnance development. He also teaches at N.O.L.—probability and statistics and their engineering applications. . . . **Viet Howard** is returning to M.I.T. as a Sloan Fellow. He writes that "Carrie and I are bringing much more luggage back—Gail, Randy, Doug and Mitch." . . . Another Ph and D went to **Brent Silver** not too long ago. He was a grad student at Stanford in aeronautics and astronautics. The thesis was all about light aircraft design. Now Brent is still at Stanford as a research associate.

And the degrees keep rolling on. . . . **Pete Fishman** got his Ph.D. in 1970 and is a staff fellow at N.I.H. working on (and I quote) "alterations of surface components of mammalian cells after viral transformation. Also I have a project on the kinetics of multi-enzyme complex involved in glycerol transfer." Sounds to me like Pete's in biochemistry. . . . **Alexander Rutchka** is still in school—part-time at least. He is at R.P.I. going after an M.S. in computer sciences. The Rutchkas have three kids now: two female, one male. . . . Although a degree isn't given for a residency it seems to me one should be given to **Richard Stifler** who is resident in psychiatry at Mass. General.

Don Morrison writes "I have been teaching at York University (in Toronto, Canada) in environmental studies and I am the director of the Methods and Analysis Section at the Institute for Behavioral Research. Starting July 1, 1971, I'll be visiting director of the Computing Center at the University of Ihadan in Ihadan, Nigeria. My first book on Africa is being published in the fall by the Free Press." . . . Another Visiting Professor is **Paul Schweitzer.** He is at the Technion—Israel Institute of Technology in Haifa, teaching industrial and management engineering.

One of the more interesting notes to arrive during the summer was from **John Stuart** who wrote "I am involved in a venture to develop new urban mass transit systems based on a new operational approach. It represents the first basic process to be proposed for transit in over a decade. I am president of the new company called Transyt Corporation." The letter was postmarked Newport Beach, Calif. . . . Also in California is **Tom Geers** who still works for the Lockheed Palo Alto Research Labs. He says he is "becoming increasingly involved in work in acoustics. I am participating in local and regional efforts to combat noise pollution even though I am a polluter myself, having taken up the folk guitar."

Final Notes: Arrigo Mingini and wife Ingrid had a daughter (Lara) born in August 1970. . . . **James Halley** was married in June of 1970 and he is an associate professor of Physics at University of Massachusetts. Have a pleasant Christmas and a fine New Year and keep those cards and letters coming.—**Andrew Braun,** 464 Heath St., Chestnut Hill, Mass.

62

The holiday season is upon us—Season's greetings to all! Certificates of Appreciation are being awarded this fall to 104 alumni whose efforts on behalf of M.I.T. in 1971 Alumni Fund played a key role in making this year such a success. Participating from the Class of 1962 were **William T. Brydges, 3rd,** and **Vito A. Caravito.**

Nicolas H. Charney, formerly of Boise Cascade's C.R.M. Inc. subsidiary, has formed his own company. Charney, founder of the magazine *Psychology To-*

day, recently purchased from Norton Simon, Inc., *Saturday Review* magazine and the trade books division of its McCall Publishing Co. . . . **David E. Nickles** became a proud father of a baby girl, Karen Joan, this past summer. Dave has transferred to the manufacturing section of du Ponts' Building Products Division. He has finished remodeling his 40-year-old English Tudor home and I am sure all of us remodelers both rejoice and commiserate with Dave. **George W. Meyer, Jr.,** is in residency in internal medicine. He and his wife are expecting their second child. George will complete his residency in San Francisco next July but has no plans yet for practicing. . . . **Rudolph H. Gawron** and his wife, Jean, became the happy parents of a second child in January. Now nine-month-old David will have a playmate. . . . Joining the baby parade also were **Don Nelson** and his wife Barbara who now have two daughters. Jody Lynn is their new addition. Don is still with Union Carbide, working in industrial engineering. He is planning to start on his M.B.A. this fall.

Dick Stein has been promoted to Professor of Physiology from Associate Professor at the University of Alberta. Dick is now happily devoting all of his time to teaching and conducting research. He has been busy with now over thirty publications to his credit.—**Gerald L. Katell,** Secretary, 122 North Maple Dr., Beverly Hills, Calif. 90210

64

The Class Hero of the month is **Steve Glassman,** who wrote to say that he is now an assistant United States Attorney in New York. Prior to assuming this position, Steve spent five weeks in the Far East on vacation. He reports that he is enjoying his bachelorhood in the Big City. . . . As for others in our Class, **Mark Barron** is an electronic engineer at General Electric in Schenectady. He and his wife Mary have a son approaching one year of age. . . . **Mike Burton** is an Assistant Professor of Anthropology at the University of California in Irvine. . . . **Norm Davis** is operations control manager of a land development being done by a subsidiary of the Manchester Bank. He has a one-year-old daughter. . . . **Joe Domine** is a project scientist at Union Carbide in Bound Brook, N.J. He received his M.E. in chemical engineering at Stevens Institute of Technology.

Leonard Gage completed his postdoctoral study at Carnegie and is now a research associate at the Roche Institute of Molecular Biology in Nutley, N.J. . . . **Jon Gruber** is an investment analyst in the technology field for an institutional investment firm, William Hutchinson and Co. He is a partner in the firm. Jon and his wife Linda are enjoying life in San Francisco. . . . **Sanford Hellman** and his wife Beth are the proud parents of a one-year-old boy named Jeremy Brian. . . . **Thomas Herbert** received his Ph.D. in biophysics at Johns Hopkins last year. He is now a research associate in the biomedical sciences department at Brown University. . . . **Michael Hirsch** is an assistant administrator in New York City's Environmental Protection Administration . . . **David Hoover** is planning director for the South Middlesex Area Chamber of Commerce. In addition, he has been appointed a Loeb Fellow in Advanced Environmental Studies at Harvard. As such, he will carry out independent research and teach several seminars.

Mayer Horn has joined the Tri-State Transportation Commission in New York City. . . . **Lawrence Kaldeck** is a senior mathematical scientist with Avco Computer Services in Wilmington, Mass. . . . **James Kotanchik** was married this past June to the former Judi Anthony. . . . **Wayne Matson** is vice president of R and D with Environmental Sciences Associates, Inc., a company involved in a systems approach to environmental medical problems. . . . **Stephen Meyer** has commenced work on a Ph.D. in clinical psychology at Fuller Graduate School of Psychology in Pasadena, Calif. . . . **Steven Schlosser** has opened a part-time tire business in addition to his regular job with R.C.A. Steve and his wife recently celebrated their fifth wedding anniversary.

Alvin Stith received his M.S. in math this past May at the University of Tulsa. . . . **Thomas Wojick** is a supervisor in the scientific instruments department at Corning. He and his wife Nancy are enjoying the Boston area together with their three children. . . . **Edward Wolcott** is currently developing a rechargeable battery for Gates. He and his wife recently had a new daughter, Charnley. . . . Let me hear from you. Best wishes for a happy holiday season.—**Ron Gilman,** Secretary, 5209 Peg Lane, Memphis, Tenn. 38117

65

It's apparently time for more pathetic pleading (as **Chico Gholz** calls it) since the stock of clippings for this month seems slim despite the influx of Alumni Fund envelopes. Maybe if I scream for letters now I will avoid the doldrums that marked the column last February and March. So write!

There have been a few letters since last month. **Dick Tsien** provided the big news in a letter with an enclosed copy of a homemade wedding program. Dick and the former Julia Shiang were married in the M.I.T. Chapel on August 29. Dick is at Yale teaching medical school students and doing research on why and how adrenaline makes heart cells beat faster. Julie is teaching in a progressive school in New Haven in an open classroom where first, second and third grades are taught together. An experimental return to the little red schoolhouse, as Dick calls it. . . . **Phil Smith** wrote to report the birth of a second daughter in August (no name in the letter). Phil is switching jobs and moving to Paris, France to join a small team of financially-oriented businessmen assigned to consolidate and straighten out the seventy companies controlled by Compagnie des Compteurs, a division of Schlumberger, Ltd. He was formerly cost control manager for Burndy Corp. in Norwalk, Conn. . . . **Art Bushkin** sent a letter in early August reporting the "latest episode in the saga of the computer scientist turned humanity saver." He had joined the staff of Pete McCloskey's campaign for the Republican presidential nomination and moved to Washington, D. C. as a newborn Republican. Art's Alumni Fund envelope, received in mid-October, reports that he has recently left the McCloskey campaign. Art is now unemployed and considering returning to the book he's been writing for the past year. Art says politics is not for people who like job security.

The alumni office sent news of a number of classmates' doings. **Samuel Drake** was among 16 Draper Lab staff members who were recognized for their part in curing the troubles with the Apollo 14 guidance system last February. . . . **Steve Dangel, Lawrence Gaydos, Peter Heinemann, Steve Kaiser, William Pike** and **Ronald Wilson** were present at Alumni Day last June. . . . **Jim Hester, Carol VanAken,** and I attended the inauguration of M.I.T.'s new president, Jerome Wiesner, in October.

Dave Rubin passes the news that Sharon is taking per preliminary exams for her doctorate this month. Dave says he and Sharon may be back East on a visit this fall. . . . **David Waltz** passes along a "hi there" to the rest of the Class and reports he is now married to the most wonderful woman in the world.

A number of people have sent us educational news. . . . **Lawrence Stark** has completed his Ph.D. (he says "piled higher and deeper") and is now in the north country working for Bell Northern Research in Ottawa. . . . **Richard Freedman** received his M.S. in computer science from the University of Western Ontario back in 1970. . . . **Leo Rotenberg** says he didn't graduate in June as he said he would (and I published) but is still plugging away. Leo worked this summer for the Honeywell Information Sciences Center but says the center just got dissolved. . . . We have received word on several Harvard degrees awarded to classmates last June. **Mike Keehner** and **Bob Paltiel** received M.B.A.'s. **Regina Herzlinger** and **Alan Leslie** received D.B.A.'s. **Allan Haberman** received an A.M. **Ron Newbower** was elected to full membership in the Harvard chapter of Sigma Xi. (Ron's Ph.D. was reported in the July-August *Review*). . . . **Bruce Morrison** has just started the educational path again, and has completed his first year at Yale Law School. Bruce was married to the former Jane W. Phillips of Park Ridge, Ill., in August, 1970 and spent this past summer at the Boston Legal Assistance Project.

Wayne Haase is still in a Ph.D. program at Stanford. Wayne's thesis will concern an implantable ultrasonic blood flowmeter. The Haases' first child Katherine was born November 16, 1970. . . . **Scott Hynek** reports the birth of a daughter Jennifer Robin on October 17, 1970. Scott is working for the Nuclear Division of Stone and Webster Engineering Corp. . . . **Hank Lichstein** is still at First City National Bank. Henry and Janine now have a son Daniel Asher (seven pounds, 13 ounces) born on August 29, 1971. Janine is fine and settling in easily as a housewife.

We also have received some news of professional activities and new jobs for classmates. **Mark Eisner** is technical director of the new Computer Research Center for Economics and Management Science. The center is an outgrowth of M.I.T. and will program and disseminate computer systems for quantitative social-science research. . . . **George McKinney** is the new financial control manager of the Corning Glass Works Manufacturing and Engineering Division. George holds a Ph.D. from Stanford. . . . **Bruce Golden** is an attorney with the Chicago law firm of McDermott, Will and Emery specializing in corporate and securities law. . . . **Martin Thomas** is working in corporate marketing information systems and heads a group of six people. (I don't have his company affiliation.) The Thomases have a son Paul, two years old and were expecting a second child in October.

Tom Perrone is working overseas for I.M.L.O.S. Marine Ltd., a small private weather consulting firm advising the oil industry. The company provides forecasts for offshore oil operations and Tom has been assigned to posts in Italy, Iran and the Trucial States (Trucial Oman) as a meteorologist. . . . Also working overseas is **Martin Breidenbach,** who reports that the trend appears to be "get out of physics or get out of the states" and is trying the latter at C.E.R.N. . . . **Christopher Ebbe** is a clinical psychologist and is serving as an Air Force Captain at Torrejon A.B., Spain. He received his master's and Ph.D. at the University of Missouri under the Air Force Institute of Technology program.

James Welch is working for Shell Oil Company in Deer Park, Texas, as a research chemist. . . . **Harry Vickers** and **Dave Barber** have started a small computer peripheral company, ENTREX, in Burlington, Mass. . . . **Barbara Vickers** is an editor for mathematics textbooks at Houghton Mifflin Boston. . . . **Jerry Robertson** is with Northeast Electronics Corp in Concord, N.H. and is involved in new systems programs there. . . . **Leonard Zacks** will soon be leaving the Rand Corp., to join the New York office of McKinsey and Company, Inc., an international management consulting firm. Leonard was recently appointed an associate editor of the journal *Management Science.*

Wayne Wilner says that now that he has his Ph.D. Burroughs must think he's too expensive: they keep sending him out of town. Wayne visited Tech in August on a trip arranged by the Industrial Liaison Office. He says he talked to some Draper Lab people who had their research unfunded and that it's a heartbreaking thing to see. . . . **Dick Larson** now has joint appointments as Assistant Professor in the M.I.T. Departments of Electrical Engineering and Urban Studies and Planning. Dick is working on operations research for urban systems. . . . **Myron Weber** will soon be joining the Department of Business Environment and Organizational Behavior in the Oregon State University School of Business and Technology.

Finally, a couple of observations from your secretary. I've recently seen the newly remodelled Burton House and it is really an amazing place. Carpeting, paint, new furniture. The room I lived in my last two years was in Burton and that space has now moved over to the Connor side. The folks in the Administration who made the commitment to remodelling deserve congratulations, especially from those of us who endured the old Burton House. I might also point out that there is still need for work on dormitories and that supporting that work is a good place for Alumni Fund contributions. . . . **John Kassakian,** back from the navy, is a graduate tutor in Burton.

On another note, **Jim Pepe** has been urging me to see if there are any classmates who are interested in getting together to have a beer and talk over old times—or whatever. This is mainly for Boston area, I guess. If so, call me or Jim (who lives in Arlington, Mass.)—**Steve Lipner,** Secretary, 3703 Stearns Hill Rd., Waltham, Mass. 02154

67

Twice during the last few weeks I have been surprised to run into classmates at the Stanford Graduate School of Business. They are **Cliff Lawrence,** who managed to get a trip out West thanks to some Washington agency, and **Gerald Tomanek,** who just enrolled in the M.B.A. program at Stanford. I will try to include some news about these guys at a later date. . . . **Mike Scott** wrote to fill us in on his activities over the past four years. After graduation he worked in the Computer Research Lab of N.A.S.A.-E.R.C. in Tech Square. As N.A.S.A. funds were cut back, the lab gradually disintegrated, and in 1969 he moved to L.A. and took a job at Computer Sciences Corporation, working on the design of a commercial time-sharing system. In December, 1969, Mike married Carol Ann Munato of Newton. In December, 1970, he was laid off because of aerospace cutbacks. After three frantic months he landed an excellent position with Univac in Valencia, Calif. He finally received a I-Y draft classification after a six-month legal battle with his draft board. Mike recently retired from the computer profession and entered a four-year joint law-architecture program at U.C.L.A.

Mark Zahn writes to update the news I included in last month's issue: "Uncle Sam decided not to induct me into his service, as I failed his induction physical, and so I continue to push a pencil at the University of Florida as Assistant Professor of Electrical Engineering. I never mentioned that Linda and I had a baby girl, Laura Michelle, born December 8, 1970. We also expect another one in January. Hope it's a boy this time." . . . **John Rible** has spent several weeks traveling around the country and seeing old friends. He looked for a job in Boston, as he plans to return there soon. . . . Nancy and **Robert Gerstle** have a baby boy, Michael Louis, born April 3, 1971. Bob has graduated from N.Y.U. Medical School and has begun a pediatric internship at Strong Memorial Hospital. . . . **Bill Klecan** is working as a manufacturing engineer for Coulter Electronics, Hialeah, Fla. . . . **Fred Goldman** received his S.M. from Sloan in 1970 and accepted employment as a management consultant with Price Waterhouse and Co. He's living in San Francisco. . . . In June, 1970, **Dan Drucker** married Susan Saltzer of Yonkers, N.Y. They are living in Berkeley where Dan is working toward a Ph.D. in mathematics. He sees fairly regularly many former Tech tools. . . . Carol and **Bob Landley** have one child, Kristin, and plan to start another soon. Carol has graduated from Stetson University, and Bob has kept his job at General Electric even though the industry is hurting. It looks like they will be in Florida a while longer.

Larry Aronberg has been released from the army and is working for a Ph.D. in business at University of North Carolina. . . . Peggy and **Alfonso Falco** have a son who is almost three. Until recently Alfonso was a structures designer on the S.S.T. He now has a layoff notice in his pocket and is working on a day-to-day basis for Boeing. . . . **Carleton Bryant** married the former Susan Costello of Wellesley Hills on July 11. Susan, a Wheelock graduate, is tutoring in the Bath, Maine, schools. Carleton is an operations analyst. . . . **Siegfried Mayr** wrote that he was planning to return to South Africa to accept some position in industry.

Leslie and **Dick Farrell** are the proud parents of a girl, Jacqueline Michelle, born October 5, 1970. Dick is a captain in the Air Force Biomedical Sciences Corps, detailed to N.A.S.A. headquarters in Washington, D.C. His tour of active duty will end in April. . . . **Terry Williams** and his wife, the former Anne Vallee, are enjoying Monterey, Calif., where Terry attends the Naval Postgraduate School. They recently returned from a sea tour in Pearl Harbor. . . . The following attended the 1971 Alumni Homecoming: **Bill Dix, Mike Dunlavey, Howard Greenbaum,** and **Bruce Ressler. . . . Carl Hewitt** has been appointed Assistant Professor in Department of Electrical Engineering. . . . **Joe Ferreira** has been appointed Assistant Professor in Urban Studies. . . . **Ronald Norelli** married the former Miss Nancy Lee Black in September. She is a senior at Wellesley, and Ron is an industrial liaison officer at M.I.T.—**Jim Swanson,** Secretary, 508 Thompson Avenue, Mountain View, Calif. 94040

68

It is October as I write this, and probably my favorite time of year. The leaves are turning, the air is crisp, and we have had some delightful days of long walks through Boston, and scenic drives in the country. As we expect not to be here much longer, we have been combining these excursions with visits to some of our favorite restaurants—truly a great way to spend one's time.

As is my custom, I shall report on the marriages first. **Ken Rosenberg** reports that he recently married Shelley Kapner. Shelley is obtaining her master's in education as a reading specialist at University of Pennsylvania, while Ken is completing his last year of law school there. . . . **Wilson Dillaway,** who is currently employed as a senior systems pro-

grammer by the University of Rochester Computing Center, was recently married to Gail Kraemer. . . . **Allen Currano** and Barbara Ann Orchard were married on July 31. Their honeymoon included a cross-country auto trip with backpacking in Yosemite and Grand Canyon and several profitable days in Las Vegas. Allen is still working at the Applied Physics Lab in Silver Spring, Md., and Barb is teaching in Montgomery County. They are now living in a recently purchased house, and they welcome letters from classmates. . . . **Steven Gamer** writes that he married Suzanne Weiner in August. . . . **Ken Morse** reports that he will marry Joan Harney on December 18. This past summer, he worked for a Boston consulting group, and he is now in his second year at Harvard B School.

On the military front, I am happy to report that most of the news is from people who are getting out. One person who is still in is First Lieutenant **John McFarren,** who was recently a navigator on a team sent from Mountain Home A.F.B., Idaho, to obtain information for flood prediction. The project involved photographing rapidly rising rivers north of the Arctic Circle to provide data on spring thaws and ice flows. . . . **John Barravecchio** recently returned from a tour in Viet Nam in a medical laboratory on Long Binh Post, and is now finishing his time in Atlanta. . . . **Anthony Trojanowski** also recently returned from Viet Nam. He had been working in Saigon, and was a First Lieutenant. In October he separated from the army, and is now awaiting replies from grad schools. . . . **Jay Sinnett** completed three years with the Navy on June 30. He is now awaiting an opening in the Environmental Protection Agency or some similar position. He says, "I feel that it is very important to start tackling environmental questions at all levels as quickly as possible."

Of course, threats of the military still loom large for some. **Alan Green,** who is presently in his third year of medical school at St. Louis University reports that he is still single and is looking for a way to avoid being drafted. . . . Several others have also reported that they are still in school. **Russell Mersereau** writes that he is an instructor in Course VI, "still plodding on toward (my) doctorate." **Andrew Friedland** is now in his third year at Harvard Law School. Last summer, he worked for the N.Y.C. law firm Kronish, Lieb, Shainswit, Weiner and Hellman. . . . **Sherman Hanna** reports that he is switching from an M.B.A. to a Ph.D. program and will probably concentrate in urban and regional development in the Department of Consumer Economics and Housing at Cornell.

We have several reports this month of people graduating from school. **Scott Davis** writes that he is getting his A.B. in psychology from Berkeley, and will continue there for his graduate work. . . . **Julian Williams** recently received a Ph.D. in comparative biochemistry, and has started medical school at Washington University in St. Louis. . . . **Burton Rothberg** is currently completing work in a doctoral program at Harvard Business School. He spent the past summer at the International Institute of Management in Berlin. . . . Finally, one person who really is finished going to school now is **David Ellis,** who graduated from Harvard Law School in June. He took the New York bar exam in July, and is now living in New York and working for the law firm, Hale, Russell and Stentzel.

We have some news on **Neil Goldstein** from his wife Carol '70. Neil is working for the Social Security Administration in New York City. Carol is working for an architect as an all-around assistant, but is planning to return to school in the near future. . . . **Robert Young** is now the assistant manager of the camera department at a new K-Mart in Allentown, Pa. His wife Kathy recently received her master's degree from Lehigh and is now a first grade teacher in Souderton. . . . **Jeff Tranen** is working in the Protection and Planning Department of the New England Electric Co., and says that he loves living out in the "sticks" of Westboro. . . . **Walter Nissen** is now director of the UNITEL Census Program. He is currently involved in making machine-readable products of the 1970 census available to educators and researchers in the M.I.T. and Harvard communities. . . . **John Brasel** is now working at G.A.F. Corporation in New York.

Steve Osheroff reports that he is now living in Trenton, N.J. He finds that life there is less than exciting at best, so tries to leave town most weekends. "After a year in the southern Caribbean," he says, "the changeable weather in the Eastern U.S. is sometimes discouraging but always interesting."

Pete and **Alexa Sorant** have written about their recent activities and their reactions to life in Durham, N.C. This past summer, Pete worked for the Low Income Housing Development Corp., on program simulating a "land bank." He is now in his second year in city and regional planning at University of North Carolina. Alexa is still programming and teaching in the biostatistics department there. They report that after one year, they have mixed, but mostly good feelings for being away from real city life. One of the good points is the discovery that there are still rivers "fit to drink." They miss the restaurants and shopping, but feel that they are probably saving money now. They tried to make up for these on a quick trip to Boston and New York last summer, but they were glad to leave the city traffic.

Finally, I have more good news to report from the Marcus household. Mike's Sc.D. thesis in electrical engineering just went to the typist, and we are about to depart on a trip to Europe. Right now, our plans after that are uncertain, but will know more when we return.—**Gail** and **Mike Marcus,** Secretaries, c/o *Technology Review,* E19-430, M.I.T., Cambridge, Mass. 02139

69

After a most enjoyable summer in sunny and smoggy Los Angeles, I am back in Cambridge for my final year of school at Harvard Law School. I have been neglecting this column for the past couple of months, so last night, our friend the blue dwarf decided to pay me a visit and proceeded to point his accusing finger at me. He must have been busy during this past summer because I have received an overwhelming number of letters and notes from our classmates. Not knowing how to handle this volume of mail, I have decided to present our class news in alphabetical order. We'll squeeze in what we can this time and the rest will appear in the next issue.

On August 14, 1971, **Sanford J. Asman** married the former Sheryl Reife of Hillside, N.J. This year Sandy will be finishing his legal education at the New York University School of Law. . . . **Burt S. Barnow** was married in December, 1970, to the former Reneé Kraus. Burt began his third year of graduate work in economics at the University of Wisconsin this fall. His wife, a graduate of the University of Wisconsin, is currently working for the University News and Publishing Service. . . . **Carl R. Bozzuto** is now working directly for the manager of Chemical and Environmental Engineering at the Knirsinger Development Laboratories of Combustion Engineering, Inc., on air pollution control systems. Carl is particularly involved in work on SO_2 removal. . . . **Robert L. Bushkoff** is with Xynetic Systems, Inc., a computer systems development group which he helped to form nearly two years ago. His title is vice president—engineering systems. . . . **Donald Collins** has completed two and a half years of medical school at Duke University and is now entering a year of independent study centered around cardiovascular physiology. Don spent this last summer with a rotation at a small community hospital on the North Carolina coast. . . . **Theodore R. Crowley** has been commissioned a second lieutenant in the U.S. Air Force upon graduation from Officer Training School at Lackland A.F.B., Texas. He has been assigned to Reese A.F.B., Texas, for pilot training. . . . **Gary C. Dixon** is working for M.I.T. in the Systems Group at the Information Processing Center. As a hobby during his non-working hours, Gary builds electronic kits. . . . **Richard W. Dorman** graduated from the Harvard Business School in June, 1971, with his M.B.A. He is now living in New York City and working with Pan American World Airways as manager—Pacific Marketing Analysis. . . . **Ray Eng** spent his summer studying for his general exam in nuclear engineering to be administered at M.I.T. in September.

Lewis Flagg is finishing his work towards an M.B.A. at the University of Chicago after spending his summer in Hawaii and Alaska. He hopes to find a place in an improving economy. . . . **Shelley Fleet** was on the D.S.R. staff doing atherosclerosis research in the M.I.T. Clinical Research Center this summer. She received her S.M. in September, 1970, for her work on athero. She left Boston in August to go to Case Western Reserve medical school in Cleveland, Ohio. . . . **Donald L. Forman** is still studying linguistics at the University of California—San Diego. This summer he traveled around the United States working on his poetry and reading it to people. . . . **Alvin Fort** is a third-year-student

at the New York University School of Medicine. He is planning a career in neurology or internal medicine. . . . **Jon D. Fricker** used this past summer to complete his master's thesis in civil engineering at the Carnegie-Mellon University in Pittsburgh, Pa. After a year as a Ph.D. candidate, he will begin his four-year stint in the U.S Army sometime around September of 1972. . . . **Doug Frost** reports he finally graduated from the M.I.T. electrical engineering department with his S.B. and S.M. after six years. He is now working on his Ph.D. in the M.I.T. psychology department. . . . On August 2, 1970, **Robert Gladstone** married the former Jacqueline Isaacson of Mattapan, Mass., a 1969 graduate of Boston University. After moving to Pittsburgh, Pa., to do Ph.D. work in urban affairs at Carnegie-Mellon University, Bob realized school was the wrong place for him. So he went to work in the Transportation Systems Planning Department of the MITRE Corp., McLean, Va. His wife is currently teaching. Bob reports he is enjoying his work and he and his wife enjoy living in Washington, D.C.

William J. Greenberg received his M.P.P. from the Harvard Kennedy School of Government in June of 1971. He has taken off for England to enter the London School of Economics. After a year of study there, Bill plans to come back to Harvard for his Ph.D. . . . **Bruce Heflinger** finished his S.B.-S.M. program in electrical engineering at M.I.T. in February, 1971. He is now doing a research project for Professor M. S. Dresselhaus at the Magnet Laboratory. Bruce is also still involved in his fraternity Phi Sigma Kappa. Starting in September, he began his work towards his Ph.D. in physics at Berkeley, the third year of his N.S.F. fellowship. . . . **Paul A. Heineken** received his M.M.S. from Rutgers University on June 4, 1971. . . . **Randall J. Hekman** is finishing his second year at George Washington University Law School and is still working in the navy as well. Randy and his wife Marcia were expecting their first child in September.

Kathryn Kanarek married Hugh R. James in the Great Court of M.I.T. on May 23, 1971. She received her S.M. and E. E. in June, 1971, and her husband finished his thesis for his C.L.E. during the summer. Their honeymoon took them to Mexico and Dallas, Texas. During their travels they met **Geoffrey Russell** and his wife. Geoff received his S.B. and S.M. in chemical engineering in June, 1970. Geoff and his wife have left for Venezuela on a special project for Esso. Kathryn is now working for Computer Systems Engineering in Burlington, Mass. Her husband is presently employed as a consultant with Arthur D. Little Co. . . . **Michael C. Keeley** received his A.M. degree from the University of Chicago in the department of economics. He plans to complete his final Ph.D. qualifying exam and his thesis seminar next fall. . . . **David P. Kelleher** reports he is still working for I.B.M. in Technology Square with Nat Rochester, Steve Zilles, and **Jim Rymarczyk**—all M.I.T. alumni or students or both. . . . **Peter T. Kleeman** is currently keeping clear of the draft as a L.T.J.G. in the U.S. Public Health Service. He is serving as a programmer in the Environmental Protection Agency and is located in Chapel Hill, N.C. . . . **William A. Klepack** is presently finishing his first year of medical school at Johns Hopkins University. . . . **James Kornberg** is pursuing his Sc.D. in environmental health science at Harvard University. He passed his written and oral exams last spring and early summer. His thesis work is being done in the area of aerosol filtration at high temperatures. His wife Sally is working at the Boston Y.M.C.A. in their university department. . . .

Jeffrey S. Lepes has finished his thesis for his M.S. in civil engineering at Carnegie-Mellon University. In September he began another master's program at the graduate school of industrial administration at Carnegie-Mellon. . . . **Theodore Lundquist** has finished a year of part-time high school teaching while taking some courses at Washington Bible College. He has also received his master's degree in physics from the University of Massachusetts and will be starting his doctoral program at the University of Maryland. . . . **Steve Maser** has completed his course work on his Ph.D. in political science and will soon be taking his qualifiers. He expects to spend the next year or two working on his dissertation. . . . **David Matheson, 3rd,** and his wife Pat have been living in Acton, Mass., just a few miles from Digital Equipment Corporation in Maynard where Dave has been working since graduation. . . . **John V. Maxham** received his master's degree from Rutgers University on June 4, 1971.

Henry I. Miller has spent the last two years as a graduate student in biology at the University of California—San Diego. In September, Henry entered an M.D.-Ph.D. program at U.C.S.D. His research into the regulation of macromolecular synthesis in mammalian cells has been exciting while keeping him quite busy. In his letter to me, Henry asked me to correct a mistake printed in this column several months ago regarding his marriage to fellow classmate **Jerry Goldstein.** Henry is a member of the class of '69 and not '68 as then reported. Jerry and Henry were married in the Kresge Chapel. Best man was Andy Seidenfeld and one of the ushers was **Andy Fillat** who spent the summer with the Boston Consulting Group before entering his second year this fall at Harvard Business School. Occasionally, Jerry and Henry are treated to a visit by Ensign Howard Ostroff who is stationed on an L.S.T. with its home port in Long Beach, Calif. Henry adds that being married to a coed is a "fantastically pleasurable experience! Everybody knows they're terrific for borrowing notes or problem sets from, but at least in the case of my coed, they apparently make excellent wives as well."

After getting his master's in chemical engineering at the M.I.T. Practice School in June, 1970, **Michael A. Neschleba** spent three months at Ft. McClellan, Ala., the home of the chemical corps and the WACs, as preparatory to fulfilling his R.O.T.C. commitment. He is now on reserve status while being employed by Polaroid doing process engineering work in their film division. Mike reports he now has the spare time necessary to enjoy the Boston area the way he could not as a tech tool. This summer he took a one-week vacation to Puerto Rico where he visited Luis Salgado, '70, whose new condominium overlooks the beach near San Juan. While in Puerto Rico he saw **Hermes Velez,** who is working on the south side of the island, Jon Borschow, '72, and Raphael Bras, '72. Mike's reserve unit spent a part of the summer at the Pedricktown Support Facility in southern New Jersey where he saw the "biggest mosquitoes" ever. He is presently looking forward to the ski season so he can try out the new boots and skis he bought on sale at the end of last season.

Well, this column sets a record for the class of '69. I hope we continue to set new records in the future so do your thing and let me know about it.—**Richard J. Moen,** Secretary-Treasurer, 412 Hastings Hall, Cambridge, Mass. 02138

70

After a long absence, the '70 Class Notes finally exist! This column is brought to you by me, Laura Malin, and Robert Vegeler. I finally graduated in June of '71 and am currently working at the Institute. Robert has been doing graduate work at M.I.T. under an American Smelting and Refining Fellowship and working part-time for New England Merchants National Bank as a systems analyst. He and his wife, Penelope (Indiana University '71), are hoping to go to Europe to live and work for a short period before he enters law school next fall. We both thank those of you who have been writing during the past few months. We hope you'll all be sending us more news, or else this column may disappear again!

". . . with idle eye
Measuring the listless plain,
I began to think again."

Several of our classmates are attending medical school: **Stephen F. Cooper** has completed his first year at Harvard Medical School and writes, "it was easier than M.I.T. was for the first 3½ years!" . . . **Jason Zielonka** and **Irv Asher** are both at Yale. Jason, who is on the board of editors of the *Yale Journal of Biology and Medicine* and of the *Journal of the History of Medicine and Allied Sciences,* finds med school "very exciting, challenging." . . . **Dean Roller** is in his second year at University of Pennsylvania Medical School. He and Barbara Alterman (Barnard '70) were married on June 19, 1971. . . . Also at University of Pennsylvania Medical School is **Steven Sondheimer,** who married Natalie Schreiber, of Waycross, Ga., on June 20. Natalie, who attended B.U. for two years, spent a year at Hebrew University in Jerusalem and completed her studies at Temple U. . . . **Nicholas Escott** is attending McMaster Medical School in Hamilton, Ontario. . . . **Charles G. Hunter** is presently attending University of Chicago Medical School/Health Sciences.

Sydney Jackson, who was married to Nancy Laura Middleton, '71, on June 12,

1970, is currently enrolled in a Ph.D. program in nuclear chemistry at the University of Maryland. He is studying under an N.S.F. Fellowship. . . . **Ernest S. Gladney** was awarded a $500 prize for outstanding pollution research via nuclear chemistry. He is going to continue his work under a National Defense Education Fellowship, also at the University of Maryland. . . . **Stephen Cohen** is now attending Harvard Business School, after working for a year as a computer programmer and systems analyst in a small software firm. . . . **Joe Bisaccio** is also at Harvard B., and still running the *in*famous Student Center pinball machines. . . . Also at Harvard in the law-business school joint program is **Gregory K. Palm.** His wife the former Marie C. Hambalek (Bryn Mawr '70) is a course assistant at the business school. . . . **Larry Azevedo** is in his second year of graduate study in physics at U.C.L.A. He writes that he spent last summer drilling water wells and putting a new camshaft in his Model T Speedster. . . . **Fred Davidson** has been an R.A. in Medical Research at Rockefeller University since January 1971. He writes, rather mysteriously, that "last autumn, I tried to get some job experience in pollution control, and found myself face to face with the sooty incinerators of Fun City." . . . **Mark Ketchen** is a graduate student and T.A. at U.C., Berkeley. . . . **Bob Powell** is doing graduate work at Penn State. . . . **Fred Camplin** has returned to Canada and is studying law at Osgoode Hall Law School, near Toronto. . . . **James Fong,** doing graduate work in architecture at U.C., Berkeley, writes that "M.I.T. still greatest." . . . **Joseph Kubit** is in his second year at B.U., working toward an M.B.A. He is a research assistant in the Mathematics and Operations Management Division. . . . In September, **Nadine Fauth Malcolm** received an M.S. in computer science from U.S.C. She plans to continue studying toward a Ph.D. . . . **Srinivasa Murthy** is a doctoral candidate at the Harvard Graduate School of Business Administration. . . . **Janet Mertz** is doing graduate work in biochemistry at Stanford. . . . **David Dobkin,** who is now attending Harvard Graduate School in control theory, married Kathy Kram, '72, on September 6, 1970. Kathy continues in U.S.P., Course XV. . . . Paul Pelke, who received an M.S. from M.I.T. in August, is now in a Ph.D. program in rocks at U.C., Santa Barbara. . . . **Paul Burstein** is doing graduate work in Madison, Wisc.

"But the soldier pacing still . . ."

As of July, **Dick Schulze** was a first lieutenant on active duty at Hanscom Field, working as a computer systems analyst. . . . In 1970, **Jimmy Jackson** was commissioned as a second lieutenant in the air force after completing Officer Training School at Lackland. He has recently been assigned to McGuire A.F.B. in New Jersey, and has married Susan Robertson of Lynn, Mass. . . . After completing basic training at Lackland A.F.B., Airman **David Daner** has been assigned to Sheppard A.F.B. Texas, for training as a medical services specialist. . . . **John Garrity** entered the army in September of 1970 and completed basic training at Ft. Ord, Calif. Early in 1971, he completed an eight-week NIKE-Hercules fire control crewman course at Ft. Bliss, Texas. During the course, he studied the computer, switchboard, multichannel data recorder, and missile and target-tracking radars used in firing and controlling NIKE-Hercules guided missiles. Before entering the army, John was a systems analyst at Westinghouse Nuclear Energy Systems in Pittsburgh. . . . **Ronald E. Stauffer** earned his commission of second lieutenant in the army's Air Defense Artillery after finishing a year of graduate studies at M.I.T.

". . . the loves of men,
Cities entered, oceans crossed,
Knowledge gained and virtue lost,
Cureless folly done and said . . ."

The last word we had from **Bob Jones,** which was in December, 1970, was that he was working as a singer (as he did while at school) throughout the country. . . . **Gordon Tyler, Jr.,** is an associate engineer with the Hopkins Applied Physics Lab, and is living outside Washington, D.C., in Hyattsville. . . . **Bob Wilk** received an S.B. in electrical engineering and an S.B. and S.M. in management in June 1971. He and Marilyn F. Byrne were married on July 10, 1971, and toured Eastern Europe on their honeymoon. Bob is currently employed at Mellon National Bank and Trust Co. in Pittsburgh.

Paul Malek and **Robert Armstrong** have rented a house out in bucolic Maynard, Mass., both enjoying their motorcycles. Paul works for Telefile as a system programmer, while Robert is doing a bit of intercontinental traveling and computer designing for Digital Equipment. . . . Class Officer **Gregory Arenson** married **Karen Wattel** and they are living in Somerville. Greg is working while Karen pursues a graduate degree at Harvard. . . . **Cynthia C. Helgerson** has been appointed an Assistant Director of Admissions at M.I.T. after having worked at the Center for International Studies for a summer. . . . **Joe Baron** is enjoying his job as an engineer for Westinghouse in Pittsburgh while doing a little wrestling on the side. . . . **Clifton L. Buck** is an engineer for process and product development in the Linde Division of the Union Carbide Corp. . . . **John Holding** was a teaching assistant for Marshall Fisher (M.I.T. '63, Professor of Finance), while attending the business school at the University of Chicago. He is now a financial analyst for Eastern Gas and Fuel Associates in Boston.

Quote of the Month

Although this one is over a year old, it's too intriguing to omit. It came to us from New England Newsclip, which reprinted an article from the October 8, 1970 issue of *The Advocate* (Sharon, Mass.): **"Steven L. Strasnick,** son of Mr. and Mrs. Jack Strasnick of 10 Madison Ave., was granted his B.S. from Massachusetts Institute of Technology this September. Steven, a 1967 graduate of Sharon High, has been awarded a fellowship at Harvard University Graduate School and is now a" We certainly are glad to hear it.

Contest Department

Can anyone identify the author of the above-quoted lines of poetry, and also the poem from which the lines are taken? A suitable prize will be awarded to the first person who submits the correct answer to me. There's one restriction, however: in order for your answer to qualify, you must include some news about yourself or one of our classmates. (Sneaky, huh?)

That's all for this month. A very happy and healthy holiday season to you all. Pax.—**Laura Malin,** Secretary, 406 Beacon St. #1, Boston, Mass. 02115; and **Robert Vegeler,** Class Executive Committee, 511 Beacon St. A-9, Boston, Mass. 02215

"We know enough now to recognize the possibility of man-made climatic change. . . . Recent results, for example, concern the delicate balance of the processes which maintain the arctic sea ice. . . . A small change in air temperature or in solar radiation could bring . . . a climatic change of great significance to human life."

Technology Review is proud to offer its readers the summary report on *"Man's Impact on Climate,"* the 1970 M.I.T. summer study, as a bonus supplement to this issue. Use the coupon:

Enclosed is 50¢ (or 48¢ in stamps); send me the summary of "Man's Impact on Climate."

Name

Address

Mail to Technology Review, Room E19-430, M.I.T., Cambridge, Mass. 02139

SPECIAL REDUCED RATES

EIGHTH ANNUAL TOUR PROGRAM—1972

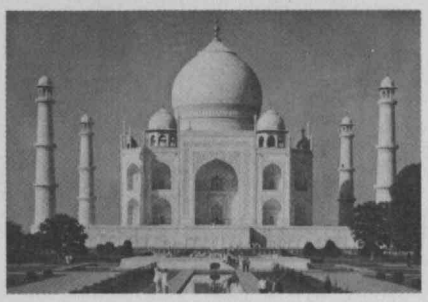
This unique program of tours is offered to alumni of Harvard, Yale, Princeton, M.I.T., Cornell, Dartmouth, Univ. of Pennsylvania and certain other distinguished universities and to members of their families. The tours are based on special reduced air fares which offer savings of hundreds of dollars on air travel. These special fares, which apply to regular jet flights of the major scheduled airlines but which are usually available only to groups and in conjunction with a qualified tour, are as much as $500 less than the regular air fare. Special rates have also been obtained from hotels and sightseeing companies.

The tour program covers areas where those who might otherwise prefer to travel independently will find it advantageous to travel with a group. The itineraries have been carefully constructed to combine the freedom of individual travel with the convenience and savings of group travel. There is an avoidance of regimentation and an emphasis on leisure time, while a comprehensive program of sightseeing ensures a visit to all major points of interest. Hotel reservations are made as much as a year and a half in advance to ensure the finest in accommodations.

EAST AFRICA

22 DAYS $1699

A luxury "safari" to the great national parks and game reserves of Uganda, Kenya and Tanzania. The carefully planned itinerary offers an exciting combination of East Africa's spectacular wildlife and breathtaking natural scenery: great herds of elephant and launch trips through hippo and crocodile in **QUEEN ELIZABETH NATIONAL PARK** and **MURCHISON FALLS NATIONAL PARK**; multitudes of lion and other plains game in the famed **SERENGETI PLAINS** and the **MASAI-MARA RESERVE**; the spectacular concentration of wildlife in the **NGORONGORO CRATER**; tree-climbing lions around the shores of **LAKE MANYARA**; the **AMBOSELI RESERVE**, where big game can be photographed against the towering backdrop of snow-clad Mt. Kilimanjaro; and the majestic wilds of **TSAVO PARK**, famed for its elephant and lion as well as its unusual Mzima Springs. Also included are a cruise on **LAKE VICTORIA** in Uganda and visits to the fascinating capital cities of **KAMPALA** and **NAIROBI**. The altitude in East Africa provides an unusually stimulating climate, with bright days and crisp evenings (frequently around a crackling log fire), and the tour follows a realistic pace which ensures a full appreciation of the attractions visited. Total cost is **$1699** from **New York**. An alternate itinerary, with a shorter stay in Uganda, visits the famed **VICTORIA FALLS**, on the mighty Zambezi River between Zambia and Rhodesia, with a total rate of **$1759** from **New York**. Departures in January, February, March, May, June, July, August, September, October, November and December 1972 ($25 additional for departures in June, July, August).



THE ORIENT

30 DAYS $1759

1972 marks the eighth consecutive year of operation for this outstanding tour, which offers the greatest attractions of the Orient at a sensible and realistic pace. Twelve days are devoted to the beauty of **JAPAN**, visiting the ancient "classical" city of **KYOTO**, the modern capital of **TOKYO**, and the lovely **FUJI-HAKONE NATIONAL PARK**, with excursions to ancient **NARA**, the magnificent medieval shrine at **NIKKO**, and the giant Daibutsu at **KAMAKURA**. Visits are also made to **BANGKOK**, with its glittering temples and palaces; the fabled island of **BALI**, considered one of the most beautiful spots on earth; the ancient temples near **JOGJAKARTA** in central Java; the mountain-circled port of **HONG KONG**, with its free port shopping; and the cosmopolitan metropolis of **SINGAPORE**, known as the "cross-roads of the East." Tour dates include outstanding seasonal attractions in Japan, such as the spring cherry blossoms, the beautiful autumn leaves, and some of the greatest annual festivals in the Far East. Total cost is **$1759** from **California**, **$1965** from **Chicago**, and **$2034** from **New York**, with special rates from other cities. Departures in March, April, June, July, September and October 1972.

AEGEAN ADVENTURE

22 DAYS $1329

This original itinerary explores in depth the magnificent scenic, cultural and historic attractions of Greece, the Aegean, and Asia Minor—not only the major cities but also the less accessible sites of ancient cities which have figured so prominently in the history of western civilization, complemented by a luxurious cruise to the beautiful islands of the Aegean Sea. Rarely has such an exciting collection of names and places been assembled in a single itinerary—the classical city of **ATHENS**; the Byzantine and Ottoman splendor of **ISTANBUL**; the site of the oracle at **DELPHI**; the sanctuary and stadium at **OLYMPIA**, where the Olympic Games were first begun; the palace of Agamemnon at **MYCENAE**; the ruins of ancient **TROY**; the citadel of **PERGAMUM**; the marble city of **EPHESUS**; the ruins of **SARDIS** in Lydia, where the royal mint of the wealthy Croesus has recently been unearthed; as well as **CORINTH**, **EPIDAUROS**, **IZMIR** (Smyrna) the **BOSPORUS** and **DARDENELLES**. The cruise through the beautiful waters of the Aegean will visit such famous islands as **CRETE** with the Palace of Knossos; **RHODES**, noted for its great Crusader castles; the windmills of picturesque **MYKONOS**; the sacred island of **DELOS**; and the charming islands of **PATMOS** and **HYDRA**. Total cost is **$1329** from **New York**. Departures in April, May, July, August, September and October, 1972.

MOGHUL ADVENTURE

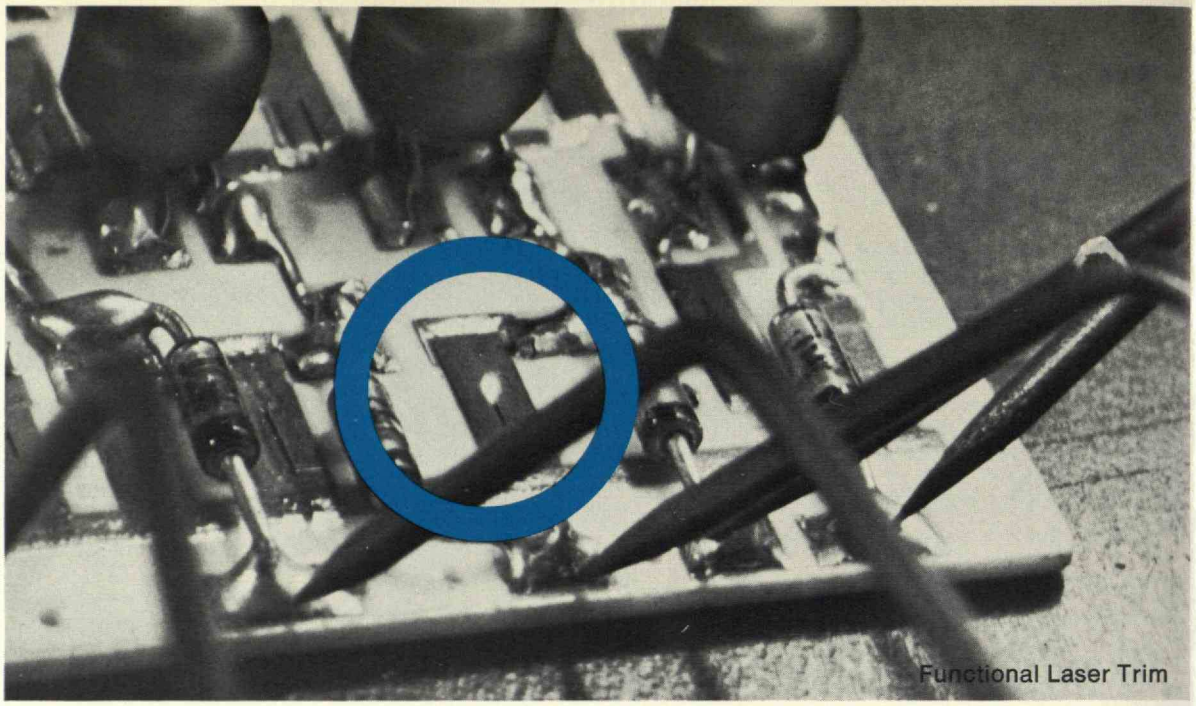
29 DAYS $1725

An unusual opportunity to view the outstanding attractions of India and the splendors of ancient Persia, together with the once-forbidden mountain kingdom of Nepal. Here is truly an exciting adventure: India's ancient mounuments in **DELHI**; the fabled beauty of **KASHMIR** amid the snow-clad Himalayas; the holy city of **BANARAS** on the sacred River Ganges; the exotic temples of **KHAJURAHO**; renowned **AGRA**, with the Taj Mahal and other celebrated monuments of the Moghul period such as the Agra Fort and the fabulous deserted city of Fatehpur Sikri; the walled "pink city" of **JAIPUR**, with an elephant ride at the Amber Fort; the unique and beautiful "lake city" of **UDAIPUR**; a thrilling flight into the Himalayas to **KATHMANDU**, capital of **NEPAL**, where ancient palaces and temples abound in a land still relatively untouched by modern civilization. In **PERSIA** (Iran), the visit will include the great 5th century B.C. capital of Darius and Xerxes at **PERSEPOLIS**; the fabled Persian Renaissance city of **ISFAHAN**, with its palaces, gardens, bazaar and famous tiled mosques; and the modern capital of **TEHERAN**. Outstanding accommodations include hotels that once were palaces of Maharajas. Total cost is **$1725** from **New York**. Departures in January, February, August, October and November 1972.

Rates include Jet Air, Deluxe Hotels, Most Meals, Sightseeing, Transfers, Tips and Taxes. Individual brochures on each tour are available.

For Full Details Contact:

ALUMNI FLIGHTS ABROAD
White Plains Plaza
One North Broadway
White Plains, N.Y. 10601

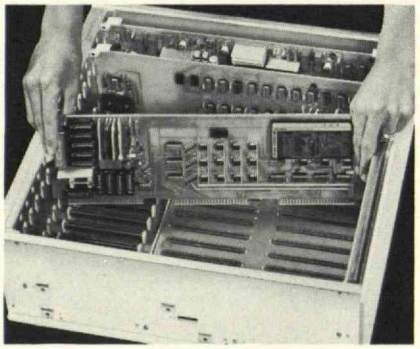


Resistance Trimming is only the beginning...
complete functional trimming is now a reality

Resistance trimming at speeds to 10,000 trims per hour and accuracies to ±0.1% is only the beginning with Micronetic's new Model 80 Laser Trim System. Now you can select the specific functional trimming capabilities you need to trim your fully assembled hybrid circuits.

Functional trimming is fast and economical

Trimming assembled hybrid circuits to a functional specification can compensate for active device variations through the adjustment of only a few resistors. Throughput increases, yield improves, and the need for a separate final test operation is eliminated. In addition, because the Model 80 can functionally trim to compensate for wide fluctuations in active device parameters, specifications on these active devices can be relaxed for substantial added cost savings.



General Radio instrumentation makes it possible

Micronetic Systems has joined forces with General Radio Company to provide a complete functional trimming system. The Model 80 measurement system is built by General Radio in modular plug-in form. The basic module is the Resistance Measurement Unit, standard on the Model 80. Separate plug-in modules to measure ac and dc voltage and current, frequency, and capacitance are available as options to provide complete functional trimming capabilities.

Functional software included

Micronetic's exclusive Resistor Trimming Language (RTL) software package allows complete flexibility by controlling all parameters of the laser trim system with simple English language statements. Instructions to control all the GR plug-in modules are included in the RTL software supplied with every Model 80.

Lowest capital investment

The standard system, complete with the basic resistance measurement module and RTL software, costs only $59,000, net FOB Watertown, Mass. Modular expansion capability means you pay only for the capability you need.

General Radio service

The complete Model 80 System carries a full one-year warranty. Service, if required, is performed by General Radio's worldwide service organization.

Write or call Micronetic Systems or your local GR sales engineer for information on how you can save money with the Model 80. Resistance trimming is only the beginning . . .

Micronetic Systems, Inc. 60 ARSENAL STREET, WATERTOWN, MASSACHUSETTS 02172 617 926-2570
A GR ASSOCIATE

General Radio

NEW YORK (N.Y.) 212 964-2722 (N.J.) 201 791-8990 • BOSTON 617 646-0550
CHICAGO 312 992-0800 • WASHINGTON, D.C. 301 881-5333 • LOS ANGELES 714 540-9830
TORONTO 416 252-3395 • ZURICH (01) 55 24 20
GRASON-STADLER 617 369-3787 • TIME/DATA 415 327-8322